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SEA USE PLANNING AND ZONING MANAGEMENT: AN EMERGING NATIONAL NE--ETC(U)

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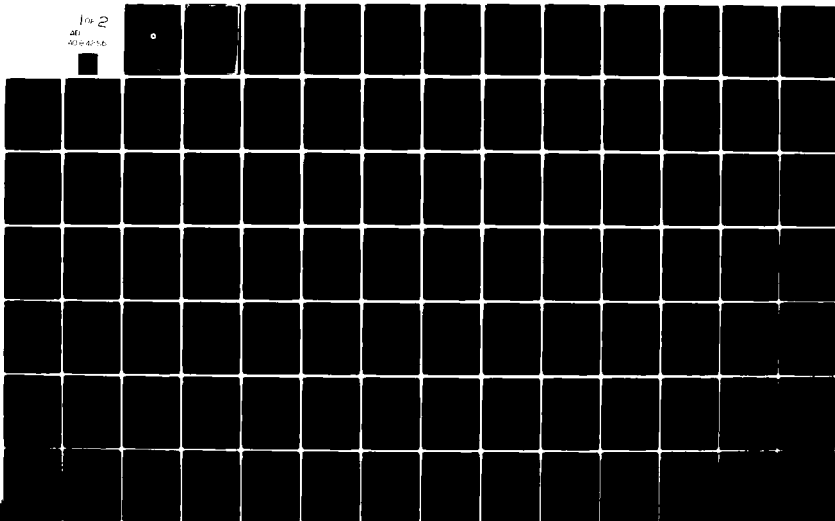
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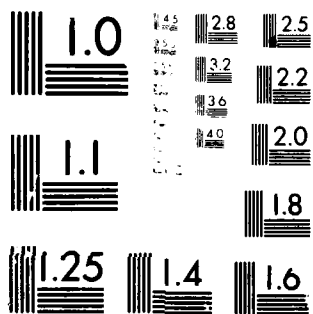
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SEA USE PLANNING AND ZONING MANAGEMENT:
AN EMERGING NATIONAL NEED
AND COAST GUARD IMPLICATIONS

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JULY 1978
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Prepared for

U.S. DEPARTMENT OF TRANSPORTATION
United States Coast Guard
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Washington, D.C. 20390

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Subj: Comments on Sea Use Management Study by Charles W. Williams, Inc.

1. This study was performed for the U.S. Coast Guard Office of Research and Development, Marine Technology Division by Charles W. Williams, Inc., Arlington, Virginia, who is responsible for the analysis and accuracy of the information presented herein. The report does not reflect the official views or policies of the U.S. Coast Guard and is not to be construed as a standard, a specification, or a regulation.

2. This report is forwarded to the technical and scientific communities in the interest of providing further information on:

- a. a forecast of probable uses of the marine economy to the year 2000.
- b. concepts and criteria for a sea zoning plan including alternate national strategies for its implementation
- c. possible Coast Guard roles in a sea use plan.

3. The U.S. Coast Guard does not concur with all elements of this analysis. Consequently, no Coast Guard endorsement of the author's conclusions concerning alternative national strategies for implementation of a sea use plan or the Coast Guard's possible role in a plan should be implied.

G. J. ROY
Acting Chief of Staff

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15. Abstract The objectives of the study were to develop a sea use plan which would be appropriate for the emerging marine economy in the years 1977 to 2000, and to determine the possible Coast Guard roles within sea use management. The probable uses and activities of and within the marine economy were described to the year 2000. Concepts and criteria were developed for a sea use plan which could enhance the management of the marine economy. A sea use plan/sea zoning process was developed for the projected marine economy along with alternative strategies for national implementation of the sea use plan. Finally, possible Coast Guard roles were described in implementing the sea use plan and the sea zoning process. The appendix contains tailored macro/marine environmental forecasts related to sea use planning and sea zoning.		
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METRIC CONVERSION FACTORS

Approximate Conversions to Metric Measures			
Symbol	When You Know	Multiply by	To Find
LENGTH			
in	inches	2.5	centimeters
ft	feet	30	centimeters
y	yards	0.9	meters
m	miles	1.6	kilometers
AREA			
sq in	square inches	6.5	square centimeters
sq ft	square feet	0.09	square meters
sq yd	square yards	0.8	square meters
sq mi	square miles	2.6	square kilometers
ac	acres	0.4	hectares
MASS (weight)			
oz	ounces	28	grams
lb	pounds	0.45	kilograms
skt ton	short tons (2000 lb)	0.9	metric tonnes
VOLUME			
qt	quarts	1.1	liters
pt	pints	0.47	liters
gal	gallons	3.8	liters
cu ft	cubic feet	0.03	cubic meters
cu yd	cubic yards	0.76	cubic meters
TEMPERATURE (exact)			
F	Fahrenheit temperature	$(F - 32) \times \frac{5}{9}$	Celsius temperature
C	Celsius temperature	$C \times \frac{9}{5} + 32$	Fahrenheit temperature

*1 in = 2.54 (exactly). For other exact conversions and more detailed tables, see NIST Spec. Pub. 26, *Units, Symbols, and Abbreviations*, Price \$2.25, NIST Catalog No. C13.10.266

METRIC CONVERSION FACTORS

Approximate Conversions from Metric Measures			
Symbol	When You Know	Multiply by	To Find
LENGTH			
cm	centimeters	0.04	inches
m	meters	0.3	yards
km	kilometers	0.6	miles
AREA			
sq cm	square centimeters	0.16	square inches
sq m	square meters	1.2	square yards
sq km	square kilometers	0.4	square miles
ha	hectares (10,000 m ²)	2.5	acres
MASS (weight)			
g	grams	0.035	ounces
kg	kilograms	2.2	pounds
metric ton	metric tonnes (1000 kg)	1.1	short tons
VOLUME			
l	liters	0.03	fluid ounces
ml	milliliters	2.1	fluid ounces
cl	centiliters	1.06	quarts
dl	deciliters	0.26	gallons
m ³	cubic meters	35	cubic feet
km ³	cubic kilometers	1.3	cubic miles
TEMPERATURE (exact)			
C	Celsius temperature	$(C \times \frac{9}{5}) + 32$	Fahrenheit temperature

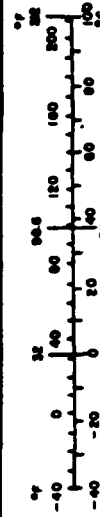


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CHAPTER 1: INTRODUCTORY SUMMARY

This report results from a specific assignment to perform the following tasks.

1. Development of an overall description of the probable uses and activities of and within the marine economy to 2000 A.D.
2. Development of concepts and criteria for sea zoning which could enhance the management of the marine economy
3. Development of a sea use plan for the projected marine economy
4. Development of alternative strategies for how the nation could implement the sea use plan
5. Development of descriptions of possible Coast Guard roles in implementing the sea use plan
6. Development of an appropriate final report

As these tasks are stated one expects to find a series of preceding sea zoning decisions to be collectively summarized into an overall sea use plan. As work progressed, it became clear that a reversal of this relationship is in order. The sea use plan precedes the sea zoning decisions and provides the framework within which zoning decisions are made. As will be seen, this distinction is not trivial. It is an important relationship for the reader to absorb from the very beginning.

BRIEF HISTORIC BACKDROP

Neither sea use management, nor sea zoning are new concepts. They have been practiced in varying degrees of detail for years. Navigational charts and channel guides are aspects of both sea use management and sea zoning.

Current efforts of the federal government to lease the rights to offshore minerals are another dimension of both these concepts. Radioactive nuclear waste dumps and other designated dumps, controlled fishing quotas, and many other forms of contemporary marine management all are acts of sea use management and zoning.

Institutional structures such as marine-related government agencies also have been built with this same management process in mind. The coastal management plans are an important part of those structures, as are the assigned responsibilities of the many agencies of government involved in some way with promoting, controlling or conducting activities within the marine environment.

Thus, we have at least some form of sea use management systems and sea zoning today, and have had such systems since the earliest days of man's exploitation of the seas.

During the course of this research, many types of charts and maps were collected showing various aspects of the marine environment. The ocean floor, probable mineral and oil deposits, dominant migration patterns of main commercial fish species, water depths and temperatures, transportation channels, and many other specialized charts exist. Each of these represents an area of marine activity which is a component of the sea use management and sea zoning processes currently in being. Hundreds of private institutions currently are operating within, or plan to become operational within, the marine environment in diverse ways. These, too, are a part of the overall process.

However, there is no coherent overview of the integrative way in which the many specialized activities and functions relate to one another within specific geographic areas. Some such integrative views exist for very limited areas, such as the geographic area under the control of a given port authority. But there is not in existence an integrative sea use management system nor is there a sea use plan of the types described in the foregoing operational definitions.

Many activities within the marine environment are beginning to converge in ever-increasing ways. Overall, activities are going to become both more diversified and more intensive. As we have seen the overall governance of land development evolve, so we are now seeing such evolution of overall governable development of the sea; there is a need for integrative sea use planning and management. It is highly probable that such a system will evolve over the next decade. The purpose of this report is to conceptualize the various attributes which such systems will possess, and to relate these attributes to applicable Coast Guard roles and missions.

One could argue that the Coast Guard has little interest in taking a leadership role in conceptualizing these future developments, and in particular, in sea use management and planning. But such an attitude overlooks the very key role which the Coast Guard now plays and will continue to play in the future. In fact, at present, the Coast Guard is a focal agency in which several general themes of sea use management and planning come together in unique ways.

In particular, these roles involve the relatively singular responsibilities related to safety and law enforcement. The general themes of the potential military/defense support roles, public safety, and law enforcement are perhaps the most significant contemporary forces where the true interrelationships of specialized functional interests must come together. In this sense, the Coast Guard will be called upon increasingly for information and advice on how proposed developmental activities should come together. If no other agency is required to map/coordinate/develop the geographical and operational interrelationships of all these activities, then the roles and missions of the Coast Guard may be the forcing function which will require the achievement of these tasks. For how else can one evaluate the rapidly growing ways in which public and private policies, plans and activities will come together in terms of safety, law enforcement implications, protection of life and property, and at least some dimensions of effective environmental quality?

We must realize, at the same time, that the Coast Guard does not have and likely will not have the responsibility of marine development or complete marine management. Thus, even though the substance of the materials may be almost completely consistent with needs for developmental management, the motivations and uses of marine-related information may be for a different function.

We must also recognize that even though a system of sea use management and planning and zoning is emerging, it is not emerging in an integrated fashion, with one agency having the full and comprehensive responsibility. Moreover, even if this were the case, there are many elements of the present management plans which inevitably would be carried into that system.

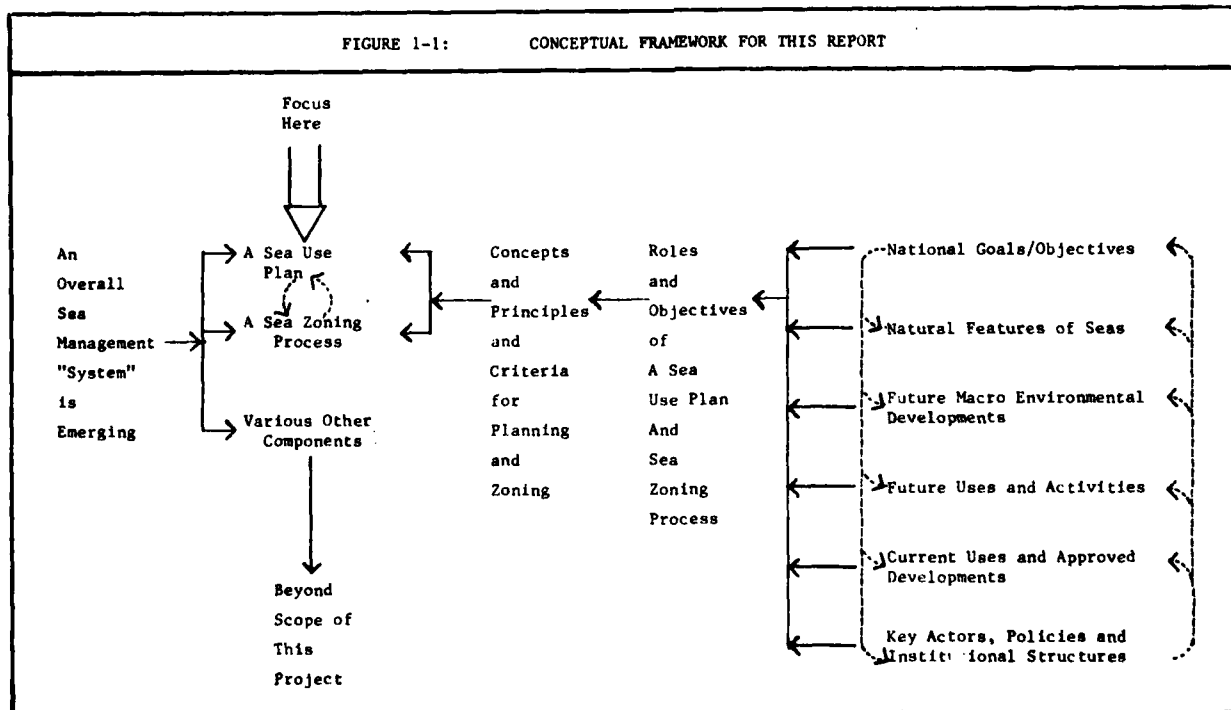
Thus, we are not starting from zero. Many of the fundamental components of the sea use planning, management, and zoning concepts, practices, principles, criteria, and institutional structures already exist in some form. These will be borne constantly in mind as the following analysis unfolds.

FRAMEWORK FOR ANALYSIS

The conceptual framework for this report is summarized in Figure 1-1. Beginning at the left, an overall sea management "system" is emerging. This "system" includes many components, two of which are a sea use plan and related process and a sea zoning process. It is these two components with which this report is concerned.

The sea use plan provides the policies and primary sea use allocations. The sea zoning process applies these by controlling operational access of specific activities to specific locales.

Now shift to the extreme right of the figure and begin reading toward the left. The various factors listed on the right comprise the operational environment within which sea use planning and zoning processes must work. These factors interact in complex and dynamic ways from which is ultimately shaped the roles and objectives of a sea use plan and sea zoning process. These roles and objectives in turn become the basis for the more specific sea planning and sea zoning concepts, principles and criteria which are applied to yield a sea use plan and sea zoning process.



For purposes of this report, sea use management, plan and zoning are defined as follows:

- Sea Use Management. That set of processes whereby goals, policies, and decisions are made which result in conducting activities within the marine environment in a manner which provides for overall national welfare, the public good, safety, and responsible stewardship of the marine environment and resources. Sea management processes involve state and local governments, special authorities, and many private institutions of both an industrial and nonindustrial nature.
- A Sea Use Plan. The term "A" denotes a singular form. In reality, there are many sea use plans of varying time horizons and specificity. We consider here that "A Sea Use Plan" is the combination of factors developed and administered by the federal government or related state and local governmental counterparts which together determine what will be incentivized, permitted and/or prohibited in terms of uses and activities within the marine environment. The components of the plan include goals, policies, and criteria for deciding among the competing or conflicting uses, and the processes whereby these acceptable and nonacceptable activities are dynamically adjusted from time-to-time, and the processes for monitoring and enforcing the activities. In this sense, the Sea Use Plan which we are conceptualizing here is the integrative result of complex processes which are technological, economic, political, and social in nature. It is a focal point from which many more detailed and institutionally and/or individually related plans may evolve, into which they may feed and around which they may revolve.
- Sea Zoning. That set of processes whereby the various uses and activities are associated with specific locales and related conditions under which they may or may not be conducted. In essence, sea zoning is the process of access control in specific geographic locations. Sea zoning links the sea use plan with geography and includes also the set of governing and management processes whereby these linkages are determined and enforced. Thus, sea zoning embodies the same conceptual complexity as does "A Sea Use Plan," although the substantive composition of the specific processes and data may vary considerably.

SUMMARY OF THE COMPONENTS OF A SEA USE PLAN AND SEA ZONING PROCESS

It follows from these definitions that a sea use plan should be a strategic policy planning document at a rather generalized level for policy guidance and generalized area designations of primary uses. The sea zoning process is a localized process which is employed essentially as an access control and activity monitoring mechanism. The sea zoning process does not stipulate a set of uses, but rather outlines the principles and criteria for unsafe or incompatible conditions among various uses relating them to the primary use which will have first priority in terms of multiple use relationships. Each zone then remains available for any combination of uses which do not conflict in unacceptable ways with other uses in the zone or with the planned primary use even though such use may have not yet been activated. Any person can petition or apply for a use permit or license to conduct these or any other activities within any zone.

The key components of the sea use plan/zoning process are summarized in Figure 1-2. Each component is developed in the subsequent pages.

FIGURE 1-2: COMPONENTS OF A SEA USE PLAN AND ZONING PROCESS

1. Set of national goals and objectives vis-a-vis the seas
2. Integrative inventory of relevant natural features
3. Forecast of future macro environmental developments, related sea uses and activities and associated technological, economic, political and social dynamics
4. Definitive inventory of current uses and activities
5. Inventory key actors, policies and institutional structures
6. Definitive set of objectives for the "Sea Use Plan"
7. Definitive set of roles and objectives for sea zoning
8. Appropriate structure for regionalization
9. Appropriate overall organizational structure
10. Principles and guidelines for making use allocations
11. Integrative strategic sea use plan
12. Supporting sea zoning process

National Goals and Objectives

The national goals and objectives vis-a-vis the marine environment or the seas must be sufficiently substantive and definitive to serve as strategic planning and operational policy guidelines for purposes of developing the uses of the sea.

The following listing represents an articulation of derived governmental objectives vis-a-vis the marine environment:⁽¹⁾

1. To develop and employ the resources of the sea in manners most supportive of and complementary of the overall balance of the U.S. Economy. To incentivize and encourage the development of the marine economy as a diversified and balanced set of industrial and economic activities in its own right. Hence, a balance between exploitation of nonrenewable resources, development and management of renewable resources, and related development of the natural forces which can be harnessed in the service of man--such as energy generation via natural tides, currents and thermal gradation.
2. To develop, when appropriate, the sea as a recreational preserve which provides access to those individuals who derive pleasure in sea-related activities for their leisure time.
3. To assure effective stewardship of the sea as a natural resource, and to protect the waters and beds from inordinate and harmful pollution caused by the injection of foreign elements resulting from man's activities.
4. To employ the sea as a natural waste disposal system to the degree that such materials disposed of therein can be either biologically absorbed and neutralized or to the degree that such injections can serve to increase the productive capacity of the sea as a resource. For example, certain wastes can serve as nutrients for fish populations, increasing the productivity of the seafood capacity.
5. To employ to the maximum advantage the sea as a natural medium of transportation, especially of bulk transportation.
6. To maintain sufficient control and surveillance over the seas so as to assure against their use as a means of an aggressor nation acquiring a threatening advantage against the U.S., and to likewise maintain sea related U.S. military capability sufficient to secure the military and defense objectives of the U.S.

⁽¹⁾ For a detailed discussion of how these were developed see: C. Williams et al., *Emerging Environments, Roles and Activities of the U.S. Coast Guard to 2000 A.D.*, Charles W. Williams Inc., May 1977.

7. To provide sea development patterns which make feasible adequate safety and protection of life and property: especially as related to the concepts of public safety.
8. To provide an effective network of laws governing sea activities or land-based activities fed through the sea.
9. To facilitate the growth of both basic and applied research and technological knowledge related to the sea in all of its facets.
10. To assure that all of the foregoing are achieved within the general context of U.S. policy, values and constitutional principles, including capitalistic/free enterprise and the competitive economy.

While this list is not exhaustive, it is judged to be sufficiently representative to serve the purposes of developing concepts and criteria for a sea use plan and for sea zoning.

Integrative Inventory of Relevant Natural Features

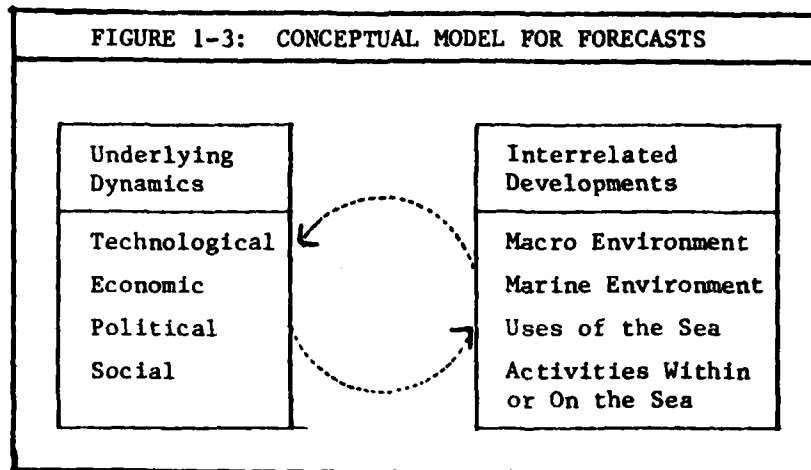
Relating all natural features of the marine environment to the sea use plan and zoning is not essential. However, the uses of the sea and activities within it are heavily determined by the natural features of the marine environment. For example, oil wells are without purpose unless there is oil at the end of the shaft. Fishing requires adequate fishing grounds. Transport vessels must have adequate draft, sufficiently open waterways and safe harbors. Pleasure and recreational craft must have pleasant and recreational conditions. The list could be much longer, but the concept is evident.

Each use and specific activity requires different operational conditions. Technology often overcomes otherwise insurmountable barriers. Thus, there are only the most general types of principles which can be stated. The natural features must be individually evaluated on a case-by-case basis with respect to the particular activity and locale under consideration.

The map for the sea use plan can be at a very general level. The maps, however, for the sea zoning process must be in a much greater detail outlining local situations within appropriate sectional grids.

Illustrative maps of the generalized type are contained in Chapter 4.

Forecasts of Future Macro Environmental Developments, Related Sea Uses and Associated Technological, Economic, Political and Social Dynamics



There are close and complex interrelationships between the four sets of underlying dynamics and the four levels at which one needs to view the future developments. In essence, each of the items in each column connects with every other item in the two columns. For simplification, we have shown this total multiple relationship by the dotted circular arrows in the center.

The macro environment is that environment which is common to all individuals and institutions within the United States. Portions of this macro environmental forecast are global in nature. Portions are essentially national in nature.

The marine environment, for purposes of this report, is that area of the seas which is under some form of economic, territorial or other control of the United States. This also includes the ports which connect the land and sea based activities. Inland waterways, however, are excluded from the scope of this analysis.

Sea uses are broad classifications of goal-oriented objectives for which activities within the marine environment are conducted. Activities are the specific types of actions and related equipment/systems which are found to be operating within the marine environment.

The macro/environmental forecasts are presented under the categories shown in Figure 1-4. A summary of these forecasts is contained in Chapter 2. A more detailed discussion is contained in the Appendix.

FIGURE 1-4: CATEGORIES FOR MACRO/MARINE ENVIRONMENTAL FORECASTS

- Political and Military Developments
- Antisocial Technology/Activities
- Economics
- Physical Resources (General)
- Ocean Minerals/Mining
- Desalination
- Living Resources
- Transportation
- Pollution/Waste Disposal Functions
- Climate and Natural Forces/Disasters
- Offshore Location of Processing Plants and Habitats
- Recreation
- Research and Development

The seas have a set of uses. How these uses are derived will determine the degree to which the development of a sea use plan is facilitated. Figure 1-5 shows the eight categories of sea uses which are developed within the sea uses/activities framework in Chapter 2. This framework represents our forecast of uses and activities of and within the seas to the turn of the century.

FIGURE 1-5: USES OF THE SEA

- Medium for the conduct of military activities
- Medium for the conduct of antisocial and criminal activities
- Source of physical resources
- Waste disposal system
- Medium of transportation
- Space for location of activities (nonmilitary)
- Medium for recreational activities
- Medium and object of research

A more detailed discussion of each of these uses, associated subuse categories and specific activities is contained in Chapter 2.

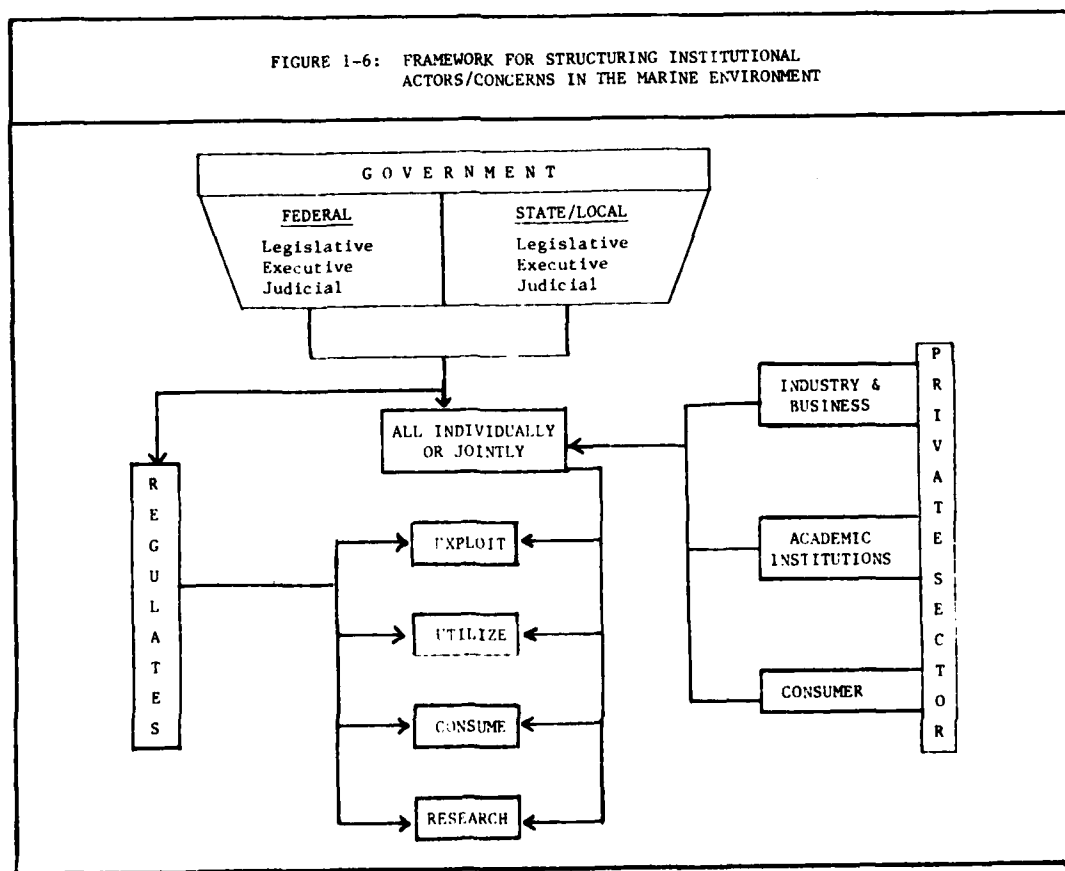
Definitive Inventory of Current Uses and Activities

During the course of the research, descriptions of current uses and their locales were developed for each of seven key regions: Upper Atlantic, Lower Atlantic, Gulf of Mexico and Caribbean Isles, Lower Pacific, Upper Pacific, Alaska and Pacific Islands. Each of these descriptions were analyzed. Two were plotted onto illustrative maps which appear in Chapter 4.

Inventory of Key Actors, Policies and Institutional Structures

The conceptual framework used to classify the key actors is shown in Figure 1-6. There are governmental actors at all levels, covering legislative, executive and judicial bodies. Governments both regulate and exploit or use the seas.

Private sector actors include industry and business, academia, and direct individual consumers. All of these individually or jointly exploit, utilize, consume, and/or research the seas.



The above framework is developed in more detail in Chapter 3.

Definitive Set of Roles and Objectives for the "Sea Use Plan"

The analysis has led to our formulation of the following proposed set of objectives for the sea use plan:

- To serve as an instrument through which to articulate in an integrated fashion how the sea is to be developed, used, and/or protected as an overall resource consistent with the national goals.
- To serve as a means for advance identification of potential conflicts in uses and to provide an orderly, equitable and just process for resolution of conflicts before they occur in reality.
- To serve as a stimulus for innovation of desired uses of the sea and/or technological development
- To serve as a retardant to innovations and continued applications for undesirable uses and technologies.
- To serve as a more definitive reference and hence informal coordinative force for the many governmental and private institutions engaged in the overall sea management system/process and sea activities.

Definitive Set of Roles and Objectives for Sea Zoning

The analysis has also been used to develop the following definitive roles and objectives for sea zoning:

Roles/Objectives of Sea Zoning

- To provide for the geographic/spatial allocations among uses and activities envisioned in the sea use plan in such a manner as to provide specific operational guidance to those who are conducting actual activities within the marine environment. These allocations should be provided and maintained in such a manner as to:
 - a) Provide geographic/spatial balance among the various uses and natural features
 - b) Provide for adequate safety of the specific areas of operation in the sense that density and interrelationships which exceed safe limits are precluded
 - c) Provide for a reasonable basis for protection of life and property from either anti-social technologies, natural disasters, or catastrophic accidents

d) Provide needed spatial controls and organization of activities to assure that military requirements are met

- To provide a ready means for identifying both problems and opportunities which define needed revisions to the sea use plan and to sea management processes
- To provide effective administrative regionalization/geographic divisions for purposes of monitoring and enforcement of the policies and laws related to uses of the sea and activities therein
- To provide a definitive guideline and basic reference document for effective access and activity control. Legitimate uses and activities for one area may not be permissible in another area depending upon local conditions. Detailed regionalized zoning charts can show these data in a dynamic/updated fashion
- To provide for advance identification of potential dangers and/or conflicts among activities within specific areas and to provide a definitive means for operators to know what can alleviate the conflict. Also to provide an orderly process for appeal and for resolution of conflict issues before the fact
- To serve as a stimulant/incentivising mechanism for innovation toward desired uses of the sea and/or technological developments resulting in compatible uses and environments
- To preclude specific unwise application of technologies and activities which may otherwise be fully acceptable and desirable
- To serve as a coordinating force for smooth interface among activities and environment within specific operational areas

Appropriate Structure for Regionalization

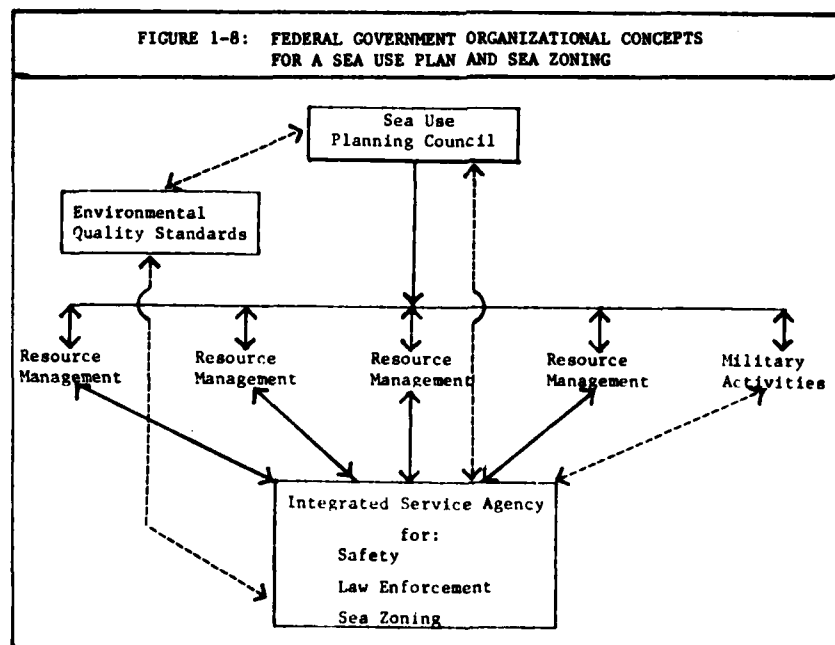
At least some degree of regionalization is needed for both the articulation of the sea use plan and for administrative practicality for functional operations. The appropriate regionalization is a composite of both natural and policy features. An analysis developing one appropriate regionalization is discussed in Chapter 3. The regions derived are summarized in Figure 1-7.

FIGURE 1-7: MATRIX FOR REGIONALIZATION OF SEA PLANNING AND ZONING				
	State Coastal Waters	National Waters	National Economic Control Waters	International Waters
Upper Atlantic*				
Lower Atlantic*				
Gulf Mexico/Caribbean*				
Lower Pacific*				
Upper Pacific*				
Alaska*				
Pacific Islands*				

* Each of these would have subheadings and lines for the activities outlined in the conceptual framework shown in Figure 2-1.

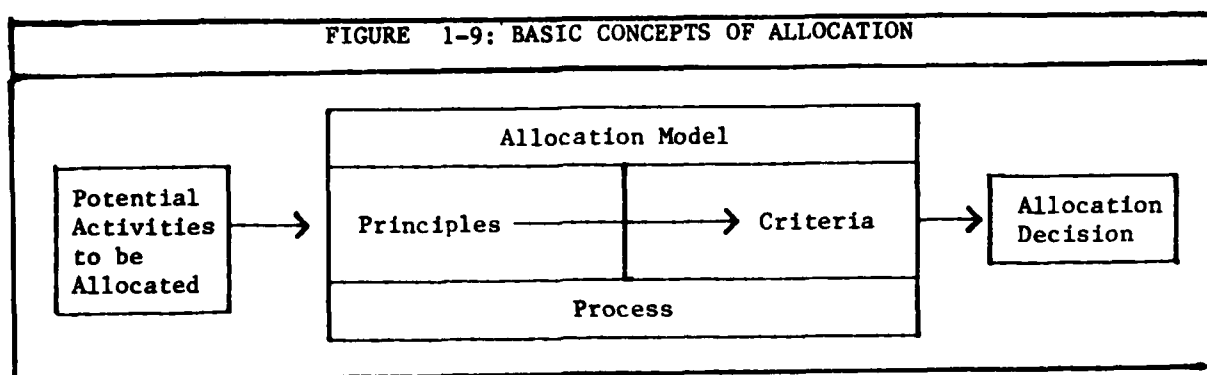
An Appropriate Organizational Structure

A set of basic organizational principles and the related organizational structure which will derive from them is developed in Chapter 3. Figure 1-8 summarizes these principles as they relate to the organization of the federal government.



Principles and Guidelines for Making Use Allocations

It is important to have a clearly understood and widely distributed set of principles and guidelines which can be expected to be followed in making the sea use allocations and zoning decisions. The basic concept is summarized in Figure 1-9.



The specific principles are developed in more detail in Chapter 3. Figure 1-10 provides a summary outline.

FIGURE 1-10: SUMMARY OF PRINCIPLES FOR ALLOCATION AMONG SEA USES AND ACTIVITIES	
1.	Principle of minimized control
2.	Principle of resource management
3.	Principle of multiple use
4.	Principle of national goal achievement
5.	Principle of access rights and due process
6.	Principle of access control
7.	Principle of security (safe and protectable)
8.	Principle of military preemption
9.	Principle of flexible allocation
10.	Principle of localized evaluation/decision
11.	Principle of precedent continuity
12.	Principle of precedent override
13.	Principle of preemptive use
14.	Principle of environmental stewardship
15.	Principle of conservation

An Integrative Strategic Sea Use Plan

An illustrative sea use plan is developed in Chapter 4. The process includes:

- Defining the appropriate level of detail
- Developing specific planning objectives for each use
- Developing operational criteria for allocation among alternative uses

In Chapter 4, the primary use concept is developed. This concept is that the sea use plan should designate primary uses only. These will serve as the principle baseline against which to evaluate what other uses and activities the sea zoning process can allow to have access to the area. Thus, the sea plan will not determine total useage at all. It will be a policy/strategy plan which will determine the key priorities to be given. These priorities are defined by naming the primary use. In addition, certain stipulations about the conditions under which activities within the primary use can be conducted might also be appropriate.

The specific steps involved in developing the sea use plan are outlined in Figure 1-11.

FIGURE 1-11: STEPS IN DEVELOPING A SEA USE PLAN

1. Division of primary uses into three sets:
 - a. Those requiring specific/unique natural features
 - b. Those not necessarily requiring unique natural features, but which are most appropriately allocated on some set of specific criteria
 - c. Those generally assignable to most waters within the region
2. Determination of initial use allocations based on current use patterns
3. Overlay of the potential primary uses based upon geographical/environmental requirements that are use specific
4. Determination of primary use priorities and allocations for uses geographically/environmentally limited
5. Determination of the remaining primary uses suitable for the region and development of planned use allocations for them
6. Determination of nondesignated or general purpose areas for which no primary allocations will be made

Supporting Sea Zoning Process

As indicated above, the sea use plan is a broad strategic policy planning document. A multiplicity of activities can be engaged in with various designated "control areas" so long as unacceptable conflicts do not arise.

The sea zoning process involves control of access to these areas in light of the specific local operational circumstances and conditions. This process should be administered by a responsible entity which is referred to as a sea zoning authority.

An illustrative sea zoning process is developed in Chapter 4. The steps involved are shown in Figure 1-12:

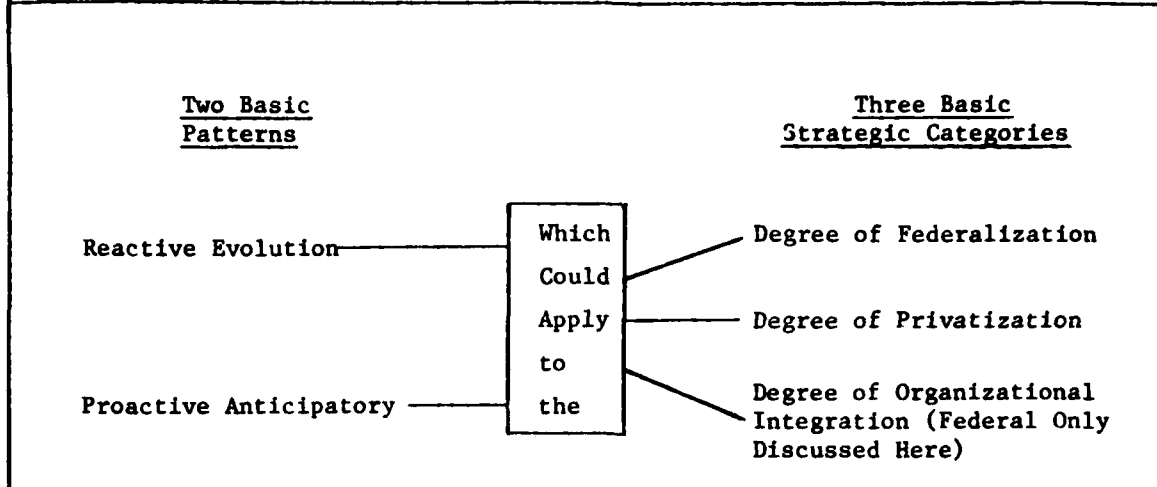
FIGURE 1-12: STEPS INVOLVED IN SEA ZONING PROCESS

- 1) Determination of the use control zones
- 2) Development and implementation of regulations related to execution of the sea use plan which have not already been developed as a part of the various responsibilities assigned other functional agencies and/or resource managers
- 3) Publication of an integrated set of regulations related to activities within each respective region
- 4) Development and maintenance of appropriate use-control mechanisms such as licenses and/or permits and the needed systems for issuance and administration
- 5) Monitoring of the various activities to assure compliance with the intent of the sea use plan and with appropriate regulations and for various other appropriate purposes
- 6) Drafting of appropriate recommendations for refinements and/or changes to the sea use plan

ALTERNATIVE STRATEGIES FOR NATIONAL IMPLEMENTATION

Task number four of the six tasks listed at the beginning of this chapter requires development of alternative strategies for how the nation could implement or might likely implement sea use planning and zoning concepts. Chapter 5 outlines these alternatives in the form of several basic scenarios. Figure 1-13 outlines the basic framework within which these scenarios are constructed.

FIGURE 1-13: FRAMEWORK FOR DEVELOPING ALTERNATIVE
NATIONAL IMPLEMENTATION STRATEGIES/SCENARIOS



Two basic patterns can develop:

- A Reactive evolutionary pattern in which national policies and actions result from crises or significant problems "after the fact"
- A proactive anticipatory pattern in which movement toward appropriate national policies and mechanisms are initiated before any more significant problems or crises emerge

Within each of these two basic patterns, there are several alternative strategies which can be classified into three basic categories:

- The degree of "federalization"
- The degree of privatization
- The degree of organizational integration (limited herein to the federal government)

In view of the forecasts of Chapter 2, only a few more years remain in which to adopt the proactive anticipatory pattern. Toward the middle to the end of the next decade, events will have advanced to a state whereby only the reactive mode is possible. Actions taken will then be within that mode.

If traditional behavior prevails, the most probable course is the reactive course. However, even within this course it is possible for individual agencies to undertake anticipatory policy/planning programs and actions within their various spheres of responsibility. This is particularly true of the Coast Guard. The

nation will be well served by such agencies beginning now to move toward this end.

THE POSSIBLE COAST GUARD ROLES

The objective of the entire project is to evolve sound concepts for Coast Guard roles in any future sea use planning and zoning process/systems. Chapter 6 outlines our analysis of such roles.

The analysis begins from the basic functional/organizational principles used to develop the concept of federal organization and summarized in Figure 1-8.

Interestingly enough, it is our view that several key roles/functions/responsibilities are most appropriately associated with the Coast Guard under all of the possible scenarios discussed in Chapter 5.

These roles are a logical extension of current Coast Guard responsibilities and operational capabilities. Moreover, there are no current agencies other than the Coast Guard which have the same operational capability and expertise which are needed for the fulfillment of these roles. The basic roles which are considered appropriate for and likely to be assigned to the Coast Guard and which are directly related to the sea plan/zoning concepts are:

- To be the lead agency for public safety and for protection of life and property in the seas
- To be the lead agency with operational responsibility for regulatory and law enforcement in the seas
- To be the agency designated as the sea zoning authority and to therefore develop the sea zoning processes/systems
- To continue its military roles and responsibilities

Chapter 6 outlines how these roles would most likely unfold under each of four basic vignettes:

- 1) Coast Guard vignette in a rapid national anticipatory mode/pattern of movement toward comprehensive and integrative sea use planning and zoning
- 2) Coast Guard vignette in a context of national policy for a sea use plan and designation of a responsible agency for such a plan
- 3) Coast Guard vignette in a context of an almost complete reactive mode/pattern of federal government and its agencies including the Coast Guard

- 4) Coast Guard vignette in a context of a dominant reactive pattern nationally, but with an anticipatory management approach taken by the Coast Guard and a few selective agencies under their own initiative

CONCLUSIONS AND RECOMMENDATIONS

The key conclusions are that the nation is inevitably moving toward some form of sea management/planning/zoning process. The types of processes/systems which will be needed to be most effective in the national interest represent significant departures from current practices. The system with which we will enter the next century will have evolved in basic structural form by the early 1990s. Thus, the issues raised are important planning issues now.

Despite the importance of dealing with these issues now, and of developing sound policies, strategies and approaches related to them, it seems most likely that the reactive mode/pattern of behavior will dominate the scene. In such a context, the Coast Guard has an especially important role to play, because of its unique capabilities and responsibilities associated with safety, protection of life and property, regulatory and law enforcement and military/defense support.

On the basis of these conclusions, the types of action considered to be the most productive route for the Coast Guard to follow are developed. They are summarized in Figure 1-14. They will prove to be sound investments under virtually any of the scenarios which might unfold.

FIGURE 1-14: RECOMMENDED NEAR TERM
ACTIONS FOR THE COAST GUARD

- Begin the background research necessary to develop interactivity protective standards oriented to property and safety.
- Begin the analyses which will provide an effective foundation upon which to evaluate the trade-offs between various degrees of rigor in interactivity standards and in the related operational missions associated with protection and regulatory/law enforcement.
- Begin to design Coast Guard equipment and organizational structures to blend into this emerging mission expansion. Equipment designs should be on hand ready for the procurement cycle even now if they are to be in the operational inventory by the mid 1980s.
- Begin to articulate its roles and responsibilities in such a manner as to receive the formal recognition and hence the full coordinative position in policies made by other agencies which have a direct and important impact on public safety, interactivity conflicts and upon the support missions and operational requirements of the Coast Guard.
- Parallel with the above steps, make a more positive movement in fulfilling its integrating role of advisor to the various public and private agencies. This in turn will require development of an organizational and manpower capability to perform such a role.
- Begin to build these concepts into manpower development and training programs, thus enhancing the flexibility and capacity of the Coast Guard personnel to absorb these roles and responsibilities and perform them with traditional Coast Guard effectiveness.

CHAPTER 2: PERSPECTIVES ON THE FUTURE MARINE ECONOMY

This chapter outlines the conceptual frameworks used in the development of our tailored forecast of future sea uses and activities to 2000 A.D.

The basic framework is shown in Figure 2-1. The way in which the sea is used depends upon (and often partially determines) the overall technological, economic, political and social developments within the macro/marine environments. Some portions of these macro/marine environments are global; others are national in scope.

These macro/marine environmental forecasts lend themselves to a classification of basic uses of the sea. These uses are related to the motivation and goals to which they are intended to contribute. These categories of use are further divided into subuse categories which in turn can be related to more specific types of activities.

FIGURE 2-1: FRAMEWORK OF FUTURE SEA USES AND ACTIVITIES

CATEGORIES FOR MACRO/MARINE ENVIRONMENTAL FORECASTS	BASIC SEA USES	SUB-USE CATEGORIES	SPECIFIC ACTIVITIES	ACTIVITY CLASSIFICATION
POLITICAL/MILITARY	MEDIUM FOR MILITARY ACTIVITIES	27 SUB-USE CATEGORIES	ABOUT 107 SPECIFIC ACTIVITIES	1. REQUIRE SPECIFIC/UNIQUE FEATURE". 2. REQUIRING OTHER SPECIAL ALLOCATION CRITERIA. 3. GENERALLY ASSIGNABLE TO MOST WATERS WITHIN A PLANNING REGION.
ANTISOCIAL TECHNOLOGY/ACTIVITIES	MEDIUM FOR ANTISOCIAL ACTIVITIES			
ECONOMIES	SOURCE OF PHYSICAL RESOURCES			
PHYSICAL RESOURCES (GENERAL)	WASTE DISPOSAL SYSTEM			
OCEAN MINERALS/MINING	MEDIUM OF TRANSPORTATION			
DESALINATION	LOCATIONAL SPACE			
LIVING RESOURCES	MEDIUM FOR RECREATION			
TRANSPORTATION	MEDIUM/OBJECT OF RESEARCH			
POLLUTION/WASTE DISPOSAL				
CLIMATE/NATURAL FORCES				
OFFSHORE PLANTS/HABITATS				
RECREATION				
RESEARCH & DEVELOPMENT				

Each activity is further classified into whether or not it requires unique natural features, special physical environmental criteria for some other reason, or is generally assignable to most waters within a planning region/area.

The uses, sub-use categories, activities and planning classifications are discussed in more detail in subsequent chapters.

SUMMARY OF THE MACRO/MARINE ENVIRONMENTAL FORECASTS.

It is probably impossible to provide a comprehensive forecast of every feature of the environment. However, two reports recently completed by our firm have provided the background for the development of a sea zoning analysis.

1. Emerging Environments, Roles and Activities of the U.S. Coast Guard to the Year 2000 A.D. (Tailored forecasts for policy and planning guidelines) (1977).
2. Future Underwater Activities and Their Implications for the Coast Guard circa 1978-2000 (1978).

The reader is encouraged to acquaint himself with those reports for a more thorough understanding of the background from which the following uses and activities have been developed. For convenience, the key features of the macro and marine environmental forecasts are summarized here. They are discussed in more detail in the Appendix.

Overall world patterns will include a pronounced proliferation of both economic and military power. This will accompany a continued trend toward governmental structures dominated by concepts of national sovereignty. An effective international agency for comprehensive ocean management and control is very unlikely. A growing array of international and multinational pacts and agreements for specialized marine activities is expected.

The proliferation of military and "military-like" capability is of particular significance. A growing array of technologies (termed by us as antisocial) offer, through nonnuclear alternatives, both small and large nations highly economically efficient ways of achieving the effective disruptive equivalent of nuclear capabilities. These developments will accompany continued nuclear proliferation.

At the same time, the resources of the ocean will grow significantly in their economic importance. Offshore investments will be much larger, more intensified, and more diversified.

Technological developments will almost revolutionize traditional naval concepts. Surface forces will become increasingly vulnerable, slowly giving way to a relative growth in underwater military systems. The military importance of the seas will grow both absolutely and proportionally while the task of maintaining world order will become more difficult.

The developing antisocial technologies also are important for another reason. They open a wide range of potentials for disruptive and damaging actions of a "terroristic type," or they could be more subtly employed against offshore assets. The initiating actors may be either governmental or private. Responsibility for such actions often will be impossible to determine. Accordingly, protection of life and property in the seas will become a much more dominant issue and problem.

Ocean resource development will become a more dominant objective than either ocean transport or recreational use. The characterization of the marine environment as an opening marine economy is valid, and it will include a wide range of diversified activities. (See listing in Figure 2-2.)

The governance, management, and coordination of the marine economy will continue to grow as a national need and issue. The United States will come to view its "marine power" as a greater vital dimension of its "national power," and of both its economic and military security. Present concepts, approaches, and mechanisms for marine governance will prove to be inadequate and insufficient. A constant theme of the next two decades will be the search for "next generation" concepts and mechanisms. This search will be taking place in a constant and rapidly changing environment, marked by many discontinuities and major technological changes.

USES OF THE MARINE ENVIRONMENT

The seas have a set of basic uses. How these uses are derived will determine the degree to which the development of a sea use plan is facilitated.

The breakdown of uses should reflect, to the extent practicable, concepts of geographical generalization, and elements of impact differentials. By geographical generalization is meant that a boundary, either small or large, is implicit with the sea use definition. By impact generalization is meant that the use has an intrinsic characteristic impact of its own in contrast to other uses.

Eight basic sea uses have been derived:

- Medium for the Conduct of Military Activities
- Medium for the Conduct of Antisocial and Criminal Activities
- Source of Physical Resources
- Waste Disposal System
- Medium of Transportation
- Space for Location of Activities (Nonmilitary)
- Medium for Recreational Activities
- Medium and Object of Research

A discussion of each of these uses follows.

MEDIUM FOR THE CONDUCT OF MILITARY ACTIVITIES

The oceans provide the U.S. and potential aggressors with an avenue, a moat, and a cover for military purposes. Thus, military activities comprise a fundamental use of the ocean.

Three basic subheadings can be identified: Strategic and Tactical Operations includes a potential or actual military conflict and the projection of military power; Support and Logistics includes those activities which provide material supplies, human back-up, and other types of support resources; Training encompasses those military operations required to be in the state of training and readiness.

MEDIUM FOR THE CONDUCT OF ANTISOCIAL AND CRIMINAL ACTIVITIES

With the development of the ocean economy a vulnerability of participating persons, resources and properties to antisocial technologies is generated. To

the extent that actors see the ocean as a medium in which to carry out their antisocial and criminal actions, we can refer to their actions as a sea use. Three subheadings can be identified: Nonmilitary Destruction of Offshore Resources/Property/Life includes those activities that are politically based, such as terrorism. The sea may also be used as an Avenue for Introduction of Antisocial Devices or Groups onto Land which can include anything from transporting explosives to drugs and illegal aliens. Finally, the ocean can be used as an Environment Within Which to Commit Crimes such as theft, murder, and other illegal conduct.

SOURCE OF PHYSICAL RESOURCES

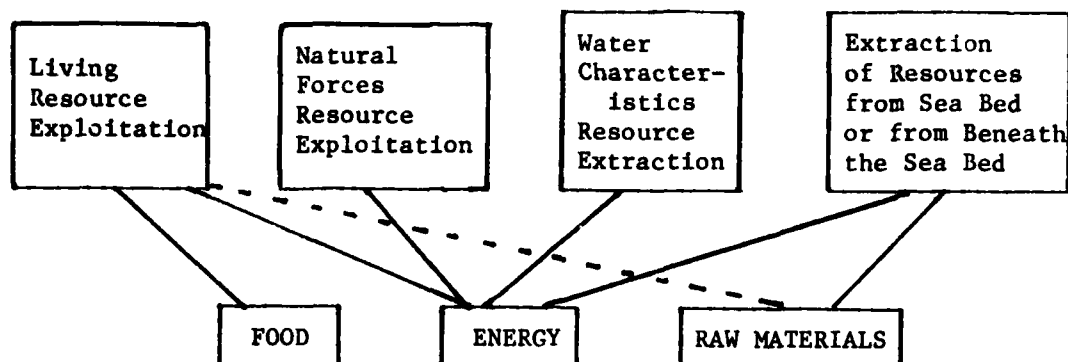
The oceans are proving to be a greater and greater source of physical resources, not only in terms of volume, but also in terms of types of resources exploited.

Under this use of the oceans, four subheadings can be identified: Living Resource Exploitation includes the exploitation of any plant, animal, or other biological organism; Natural Forces Resource Exploitation covers the exploitation of natural forces both in the atmosphere and in the water. These fundamentally are set apart from the other uses by their strong relationship to meteorology. Water Characteristic Resource Extraction represents those uses which extract resources from the chemical characteristics of the component elements of sea water. Extraction of Resources From the Sea Bed or From Beneath the Sea Bed covers both dredging from the sea bed surface and drilling or mining beneath the surface.

This delineation of uses purposefully avoids following traditional resource category lines, e.g., fish, energy, raw materials, etc. The subheadings are defined to facilitate sea use analysis. For example, energy or energy-related resources can come from any of the four subuses identified. Despite the recognition of energy as a fundamentally important resource to the U.S., it needs to be fitted into a framework reflecting the nature of the sea use employed rather than the purposes to which it will be put.

The following table should help clarify the relationships between the sea use structure and the traditional resources structure.

PHYSICAL RESOURCES



WASTE DISPOSAL SYSTEM

The ocean can be used as a repository for wastes, pollution, or any other material which must be eliminated. Four basic subheadings can be identified: the first two, Deliberate Disposal and Accidental Disposal are self-descriptive. The third subheading, Subliminal Disposal, includes land disposed materials which either through ground runoff or atmospheric settling find their way into the ocean. This sea use is indirect in nature. Managed Disposal is the last subheading which goes beyond deliberate disposal and involves a conscious effort to "fit" the waste into the marine ecosystem avoiding disruption of the marine environment.

MEDIUM OF TRANSPORTATION

The oceans act as an avenue and an environment for transportation with three basic subuses: Port Operations, Transport Through Moving Vessels, and Transport Through Fixed Systems. Port operations and transport through fixed systems include those activities which are either offshore or on the coastal area and which are permanently fixed. Transport through moving vessels represents those activities linking the modes of the fixed transport systems.

SPACE FOR LOCATION OF ACTIVITIES

Activities that traditionally have taken place on land are being tempted to move out into the ocean space. Incentives for such a development can be varied. For example, there might be greater economies of operations, availability of vast volumes of free water for cooling in heat-intensive industries, capability of water to assimilate waste materials, low density population for hazardous activities, etc.

Three basic self-descriptive subheadings are identified: Human Habitats, Industrial Operations, and Sea City Developments.

MEDIUM FOR RECREATION AND AESTHETICS

Another major use for the oceans is recreation and aesthetic enjoyment of the marine environment. We can identify three subuses: Shoreline Recreation would include beach activities; Recreational Boating would subsume all boating and boating support activities; Aesthetics Enjoyment would include the preservation and enjoyment of the marine environment for pleasure, natural conservation, and for scientific purposes.

MEDIUM AND OBJECT OF RESEARCH

A final heading for ocean use would include all research activities--governmental, private, commercial or otherwise.

FORECASTED USES/ACTIVITIES OF SIGNIFICANCE IN SEA USE MANAGEMENT, PLANNING AND ZONING

The two reports referenced earlier (page 2-1) contain significant detail outlining the rationale and basis for forecasting definitive activities which will be found in the marine environment by the turn of the century. Most of these activities are present in some form today, but they will change substantially in intensity, scope, and technological application. They also will become more important components of the overall national economy, and will, in effect, comprise a major subeconomy now becoming generally referred to as "the marine economy."

Figure 2-2 presents a summary of the overall framework, listing the various uses of the oceans and related subheadings discussed in the previous section, and further detailing these uses into specific types of activities which will be found.

The figure essentially is self-explanatory. Additional details will be discussed in following chapters as appropriate.

FIGURE 2-2: SUMMARY OF FRAMEWORK FOR FORECASTS OF FUTURE USES OF THE SEA

BASIC USE	SUB-USE CATEGORY	SPECIFIC ACTIVITIES	TIME STATUS	Requires Specific/Unique Natural Features	Requires Other Spec. Allocation Criteria Generally Assignable to Host Waters
MEDIUM FOR THE CONDUCT OF MILITARY ACTIVITIES	Strategic/Tactical Operations	<ul style="list-style-type: none"> ● Movement of Forces ● Positioning of Forces <u>which include</u> ● Submarines/Surface Vessels ● Surface/Underwater Installations ● Weapons Systems <ul style="list-style-type: none"> - land/surface/underwater - nuclear/conventional - chemical/biological - marine mammals ● Individuals/Teams/Troops 	P	X	X
	Support Logistics	<ul style="list-style-type: none"> ● Communication/Surveillance ● Securement of Channels of Military Materials Flow ● R&D ● Search and Rescue 	P	X	X
	Training/Practice	<ul style="list-style-type: none"> ● Training Program <ul style="list-style-type: none"> - personnel - target practice ● Combat Simulation 	P	X	X

P = Present
F = Future

FIGURE 2-2: SUMMARY OF FRAMEWORK FOR FORECASTS OF FUTURE USES OF THE SEA

BASIC USE	SUB-USE CATEGORY	SPECIFIC ACTIVITIES	TIME		Requires Specific/Unique Natural Features	Requires Other Spec. Allocation Criteria	Generally Assignable to Host Waters
			STATUS				
MEDIUM FOR THE CONDUCT OF ANTISOCIAL AND CRIMINAL ACTIVITIES	Nonmilitary Destruction of Offshore Resources/Property/Life (politically based)	• Terrorism	F				X
		• Vandalism					
		• Sabotage					
	Avenue for Introduction of Antisocial Devices for Groups into Land	• Small Remotely Guided Destruction Devices	F		X		
		• Smuggling of Antisocial Devices/People	P				X
SOURCE OF PHYSICAL RESOURCES	Environment to Commit Crime	• Theft	P				X
		• Hijacking					
		• Battery/Hurder					
		• Arson	F				X
		• Organized Crime	P				X
	Living Resource Exploitation	• Fisheries	P				X
		- fish					
		- shellfish					
		• Sea Ranching	P		X		
		• Aquaculture	P				X
		• Marine Plants	P				X
	Natural Forces Resource Exploitation	• Closed Ecosystems	F		X		
		• Ocean Thermal/Conversion	F	X			
		• Energy from Currents	F	X			
		• Ocean Hydroelectric	F	X			
		• Tidal Power Basins	F	X			
(CONTINUED)		• Wave Energy Extraction	F		X		
		• Wind Power Harnessing	F			X	

P = Present
F = Future

FIGURE 2-2: SUMMARY OF FRAMEWORK FOR FORECASTS OF FUTURE USES OF THE SEA

BASIC USE	SUB-USE CATEGORY	SPECIFIC ACTIVITIES	TIME STATUS	Requires Specific/Unique Natural Features			Allocation Other Spec. Generation Criteria to Most Waters		
				Requires Specific/Unique Natural Features	Allocation Other Spec. Generation Criteria	to Most Waters	Requires Specific/Unique Natural Features	Allocation Other Spec. Generation Criteria	to Most Waters
SOURCE OF PHYSICAL RESOURCES (CONTINUED)	Water Characteristic Resource Extraction	• Chemical Extraction - salt	P					X	
		- uranium	F				X		
		- other	P					X	
		• Desalination	P					X	
		• Water Salination Power	F				X		
	Extraction of Resources From the Sea Bed or From Beneath the Sea Bed	• Dredging (general) - nodules	P&F						
		- muds and ooze	F				X		
		• Drilling - petrochemical (oil & gas) - sulfur	P				X		
		- geothermal power	F				X		
		- fresh water aquifers	F				X		
		• Hardrock Mining - barite/copper - coal - other	F				X		

P = Present
F = Future

FIGURE 2-2: SUMMARY OF FRAMEWORK FOR FORECASTS OF FUTURE USES OF THE SEA

BASIC USE	SUB-USE CATEGORY	SPECIFIC ACTIVITIES	TIME STATUS	Requires Specific/Unique Natural Features	Requires Other Spec. Allocation Criteria	Generally Assailable to Most Waters
MEDIUM OF TRANSPORTATION	Ports Operations	• Inland Port Operations	P	X		
		• Coastal Port Operations	P	X		
		- ports - superports				
	Transport Through Moving Vessels	• Offshore Ports Operations (single point mooring systems--SPM's)	F	X		
		• Single Hull Carriers	P	X		
		- bulk cargo/containerships				
		- tanker				
		- cruisers				
		- other				
	Transport Through Fixed Systems	• Semi-submerged Platforms	P		X	
		• Surface Effect Ships and Hydrofoil				
		• Hydro-aircraft Landing and Takeoff				
		• Pipelines	P		X	
		• Cables	P		X	
		• Tunnels	P		X	
		• Bridges	P		X	

P = Present
F = Future

FIGURE 2-2: SUMMARY OF FRAMEWORK FOR FORECASTS OF FUTURE USES OF THE SEA

BASIC USE	SUB-USE CATEGORY	SPECIFIC ACTIVITIES	TIME STATUS	Requires Specific/Unique Natural Features			Requires Other Spec. Allocation Criteria			Generally Assailable to Most Waters		
WASTE DISPOSAL SYSTEM	Deliberate Disposal	• Municipal Residuals	P	X	X							
		• Industrial Residuals										
		• Dredge Residuals										
		• Marine Operational Wastes										
		• Radioactive Materials										
	Accidental Disposal	• Municipal Wastes	P	X								
		• Industrial Wastes										
		• Dredge Wastes										
	Subliminal Disposal	• Marine Operations Wastes	P				X					
		• Radioactive Materials	F				X					
		• "Run-off" Pollutants	P				X					
	Managed Disposal	• Atmospheric Settling Pollutants										
		• Nutrients	F				X					
		• Ecostabilizers & Restorers										
		• Naturally Degrading Disposables										
		• Artificial Reefs and Barriers										

P = Present
F = Future

FIGURE 2-2: SUMMARY OF FRAMEWORK FOR FORECASTS OF FUTURE USES OF THE SEA

BASIC USE	SUB-USE CATEGORY	SPECIFIC ACTIVITIES	TIME STATUS	Requires Specific/Unique Natural Features		
				Requires Specific/Unique Natural Features	Allocation Criteria	Generally Assists to Most Waters
SPACE FOR LOCATION OF ACTIVITIES (NONMILITARY)	Human Habitation	• Temporary/Permanent Units	P		X	
		• Transportable/Fixed				
		• Residential Complex				
		• Surface/Submerged/Submerged/Sea Bed				
MEDIUM FOR RECREATION AND AESTHETICS	Industrial Operations	• Individual Processing Plants (offshore)	P			X
		- fishing/canning				
		- floating nuclear plants	F		X	
		- raw material processing	F		X	
	Sea City Development	- petrochemical processing				
		• Industrial Complex	F		X	
		• Combined Residential and Industrial Complexes	F		X	
	Recreational (Shoreline)	• Shoreline	P		X	
		• General Boating	P	X		
		• Diving				
MEDIUM AND OBJECT OF RESEARCH	Aesthetic Enjoyment	• Fishing				
		• Marinas				
		• Marine Parks	P	X		
	Resource Inventory Meteorology Oceanography Geology	• Marine Sanctuaries	P			X

P = Present
F = Future

CHAPTER 3: CONCEPTS AND CRITERIA FOR A SEA USE PLAN AND SEA ZONING

As was discussed in Chapter 1, the concepts, principles, and criteria for sea use planning and zoning are derived from a complex network of many interacting forces which include:

- National goals and objectives vis-a-vis the seas
- Natural features of the seas
- Future macro/marine environmental developments
- Future sea uses and activities
- Current uses and approved developments
- Key actors, policies and institutional structures
- Roles and objectives of a sea use plan
- Roles and objectives of a supportive sea zoning process

Most of these areas have been discussed briefly in Chapters 1 and 2. Natural features of the seas, present uses and approved developments are discussed in Chapter 4 (in the context of an illustrative sea use plan). This chapter briefly outlines the key actors and institutional structures which are involved. It then develops the definitive concepts, principles and criteria which are considered appropriate for developing operational procedures for sea use planning and zoning under the following headings:

- Determining the appropriate level of detail
- Determining appropriate regionalization
- Principles for determining appropriate organizational structures
- Principles and related criteria for allocating sea uses among various activities

POLICIES, INSTITUTIONAL STRUCTURES AND KEY ACTORS

Current and emerging policies, institutional structures and key actors are a complex set of realities which must be envisioned within the sea use plan and zoning. Ignoring such realities will almost assure that the plan is relegated to just an academic exercise.

During our research for this project we developed an initial inventory of the key actors and institutional structures currently involved in or clearly planning to become involved within the marine environment.

Figure 1-6 (included again here for convenience as Figure 3-1) provides an initial sketch of the institutional structure.

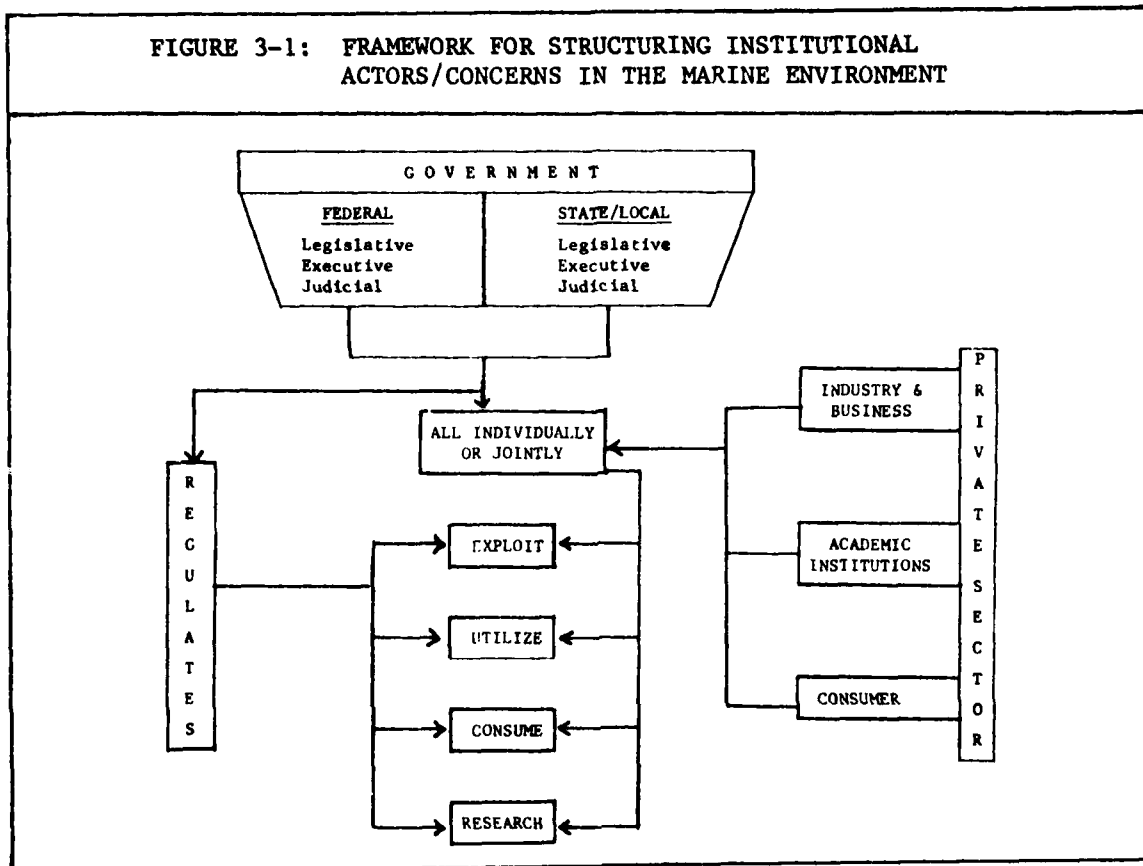


Figure 3-2 provides a more detailed outline of the key features and points associated with each category of actor/institution.

In some manner, all of these actors are constituencies whose relative weights are felt in many ways throughout the tugging of technological, economic, political and social dynamics.

In some sense, the sea use plan and zoning criteria must be seen as a reconciliatory process giving incentive to some, discouraging or prohibiting others and resolving conflicts among contenders for activities within contiguous areas which are in conflict with one another. Meanwhile, the plan must enhance the harmonizing of those activities which are either complementary or, at least, neutral toward each other.

FIGURE 3-2: SUMMARY OF THE INSTITUTIONAL ACTORS

ACTORS	CHARACTERISTICS/COMMENTS
<p><u>GOVERNMENT</u></p> <p>Federal Executive</p> <p>Congress</p> <p>State</p>	<p>Major departments are Dept. of Commerce (NOAA, MARAD), Dept. of Transportation (USCG), Dept. of Defense (USN, USA), Dept. of Interior. Departments of Energy, Justice, State, and Treasury also have significant roles.</p> <p>In addition, eight independent agencies which have marine concerns can be identified. Important ones include Environmental Protection Agency, Federal Maritime Commission, National Safety Transportation Board, and Occupational Safety and Health Review Commission.</p> <p>Basic roles of the federal government include regulatory, subsidizing, and participatory. Participatory is usually in large projects and research efforts.</p> <p>Various committees of both the Senate and the House of Representatives play significant roles in marine affairs through their legislative and regulation making functions.</p> <p>Twenty-three coastal states out of 50, and Puerto Rico, Virgin Islands, and the Pacific Trust Territories have direct concerns with the marine environment. In addition, many states border inland waterways and bodies with access to the ocean and thus also have interest in the marine environment.</p> <p>Each state has its own set of bureaucratic agencies analogous to the federal government which include many agencies interested in marine affairs. The coastal states and islands tend to have more complex networks of marine-related agencies.</p> <p>Every coastal and island entity state has presented a coastal zone management plan to the federal government for subsidy acquisition. Several have been approved.</p>

(Continued)

FIGURE 3-2: SUMMARY OF THE INSTITUTIONAL ACTORS (Continued)

ACTORS	CHARACTERISTICS/COMMENTS
<p><u>PRIVATE SECTOR</u></p> <p><u>Industrial/Business</u></p> <ul style="list-style-type: none"> ● Actively engaged in ocean operations 	<p><u>Petroleum Offshore</u></p> <ul style="list-style-type: none"> ● Several thousand wells that are not dry are inventoried by the Bureau of Mines. ● Most of the very large oil corporations are involved in offshore operations. ● There is a host of contracting companies which provide support functions in this industry. ● Ownership of industry is wholly private. <p><u>Ship Building/Repair</u></p> <ul style="list-style-type: none"> ● Approximately 188 privately owned shipyards (33 of which are capable of major shipbuilding), eight government owned naval shipyards. <p><u>Shippers/Shipment</u></p> <ul style="list-style-type: none"> ● Total waterborne commerce in 1977 was 67 billion short tons of which 44% (0.75 billion short tons) went to foreign trade of which 92% comes in through seaports. Total value of export and import shipments in 1977 was approximately \$166 billion. ● Approximately 100,000 entries and exits were cleared by U.S. Customs in 1976. <p><u>Carriers</u></p> <ul style="list-style-type: none"> ● The U.S. had 517 active ocean going vessels (over 1,000 dwt) in 1976 of which there were: <ul style="list-style-type: none"> - 211 tankers - 142 freighters - 141 intermodal vessels - 105 container ships - remainder are bulk carriers, barge carrier, and roll-on/roll-off. ● There were approximately 174 registered owner/operators in 1975 of which only 13 had ten or more vessels, the largest of which had 41 vessels (over 1,000 dwt).

(Continued)

FIGURE 3-2: SUMMARY OF THE INSTITUTIONAL ACTORS (Continued)

ACTORS	CHARACTERISTICS/COMMENTS
Indirectly Involved in Marine Activities	<p><u>Fishing</u></p> <ul style="list-style-type: none"> • In 1976 U.S. fishing vessels, motor boats, and other boats numbered 101,236. • In 1976 there were 3,660 fish processing and wholesale - establishments • In 1977 there were 96 fishery cooperatives in the U.S.
	<p><u>Recreation</u></p> <ul style="list-style-type: none"> • Various types of recreational activities can be identified: <ul style="list-style-type: none"> - Recreational boat manufacturers, about a \$5 billion a year industry in 1976, with 0.5 million boats added that year to U.S. private ownership. (This includes inland waterways. It is not possible to extract the offshore component of this sector, though it is safe to assume that it is very significant.) - Approximately 6,000 marinas, boatyards, and yacht clubs existed in 1975. - Beach front hotels. - Fishing and other water sport equipment manufacturers.
	<p><u>Pollution</u></p> <ul style="list-style-type: none"> • Industrial corporations that release wastes into rivers flowing into the oceans, or that dump directly into the oceans (total volume of released wastes and number of such actors not available to us).
	<p><u>General Industry/Business</u> (indirectly involved in marine activities)</p> <p>Difficult to identify or categorize, but these actors would include those industries and businesses which depend upon resources from the ocean for their existence such as fish distributors, shore recreation support, etc.</p>
Consumers	<p><u>Recreational Fishing</u></p> <ul style="list-style-type: none"> • In 1970 (the most recent date) there were about 9.4 million salt water fishermen. <p><u>Recreational Boating</u></p> <ul style="list-style-type: none"> • In 1975 there were about 50 million persons estimated to participate in recreational boating (including inland).

(Continued)

FIGURE 3-2: SUMMARY OF THE INSTITUTIONAL ACTORS (Continued)

ACTORS	CHARACTERISTICS/COMMENTS	
	<p>A total recreational boat inventory of 10 million boats, most of which were between 12 and 18 feet long, was recorded.</p> <p><u>Shoreline Recreation</u></p> <ul style="list-style-type: none">● Beach swimming capacity in 1965 was estimated at 6.5 million swimmers, and covered about 20,000 beach facilities. No new estimates have been developed. <p><u>Fish Consumption</u></p> <p>In 1973, per capita consumption of fish was 12.8 pounds per person.</p> <p><u>Energy and Raw Material Consumer</u></p> <p>Every American consumes energy and raw materials either directly or indirectly.</p> <p><u>Imported Goods Consumer</u></p> <p>Most Americans consume imported goods; total U.S. consumption of imported goods was valued at 2.4 billion dollars.</p>	
	<p>Professional Trade Associations</p> <ul style="list-style-type: none">● It is difficult to estimate the total number of professional and trade associations that are concerned with marine affairs. A very crude count would include a minimum of 250 associations, and perhaps many more. Many of these, of course, would have no significant basis of support for successful advocacy.● Overall initial assessment would indicate that most major private sector enterprises (particularly private industry and business) involved in marine activities are represented.● In some cases association representation of sectors is fragmented; in others it is strongly united.● Fundamental role of these associations is lobbying for member enterprises or organizations.	
	<p>Research</p> <ul style="list-style-type: none">● Between 75% and 95% of marine research is federally funded (wholly or partly)● Estimated marine or marine-related projects range between 6,000-9,000 of which 3,500 are at sea.● Job distribution in marine research by employer is:<ul style="list-style-type: none">- 40% federal or state government- 40% academic institutions- 20% private sector	

LEVEL OF DETAIL

At one extreme, a sea use plan could be envisioned as a highly definitive set of specific activities (or a list of "do's and don't's") located within specific grids of standard size denoted by longitudinal and latitudinal coordinates.

At the other extreme, there can be envisioned a set of very generalized statements of sea use goals and principles for resolving conflicting uses which is little more than a generalized philosophy having limited operational utility.

Clearly the latter extreme will fall short of operational policy guidance and articulation. On the other hand, the first extreme suffers from a variety of shortcomings which make it literally not feasible.

For example, during our research we collected dozens of charts and maps outlining currently known uses, potential uses, resource reserves and natural features of the seas. We plotted these into some test "mappings" showing all overlaps of current and potential uses. The research objective was an integrated map which coded in all potential uses within specific grid sections, analyzed their compatibility and outlined the key features of noncompatibility.

This objective is well beyond the current state-of-the-art, and the use of such a detailed activity-specific sea use plan/zoning map is not recommended. The reasons are many and varied but they can be summarized as follows:

- The current knowledge base is not adequate to permit reliable judgments of specific details of how all potential activities will interrelate within specific areas over time. Few generalizations are possible. For example, in some types of natural conditions fishing and mineral mining are incompatible activities. Within other settings, they may live well together. In other circumstances, the degree to which they conflict can be altered substantially by adopting a different technology. And the overall range of technologies applicable to future marine activities is so dynamic that there is no reliable way to work at a generalized level.
- Knowledge of where the resources of the ocean are located and in what quantities is not adequate to permit this approach. Though rapid strides are being made in mapping the organic life and inorganic materials within the marine

environment, any definitive sea use or zoning plan based upon the assumption that current mappings are all encompassing would be disproven rapidly, thus casting doubt upon the credibility of the entire concept.

Therefore, the level of detail in a sea use plan should be sufficient to provide operationally useful guidance, policy articulation, and operational strategies for patterns of ocean uses. It should not, however, be a detailed grid-specific network of highly definitive activities.

However, the zoning process should be developed in such a manner as to provide for specific application of alternative use proposals in terms of local conditions. In the assessment of such alternatives, both the current and longer term implications should be defined, including the preemptive nature of the proposed use with respect to other likely future uses. The zonal operation use permit or authorization should consider the technological compatibility of the proposed use with the marine environment. Thus, an oil derrick proposed for a well within an area that contains recreational beaches may be disapproved, but the oil well may be permissibly tapped if a bottom-based rig is employed, or, conversely, if the concept is expanded to the "floating island" idea in which the oil rig becomes a core around which various spatial uses are developed, such as an office building, a residential apartment, etc.

The sea use plan should provide the criteria for determining the conditions of compatibility in which multiple uses would be permissible. It should not stipulate what the uses are, at least for now and the next several years.

REGIONALIZATION

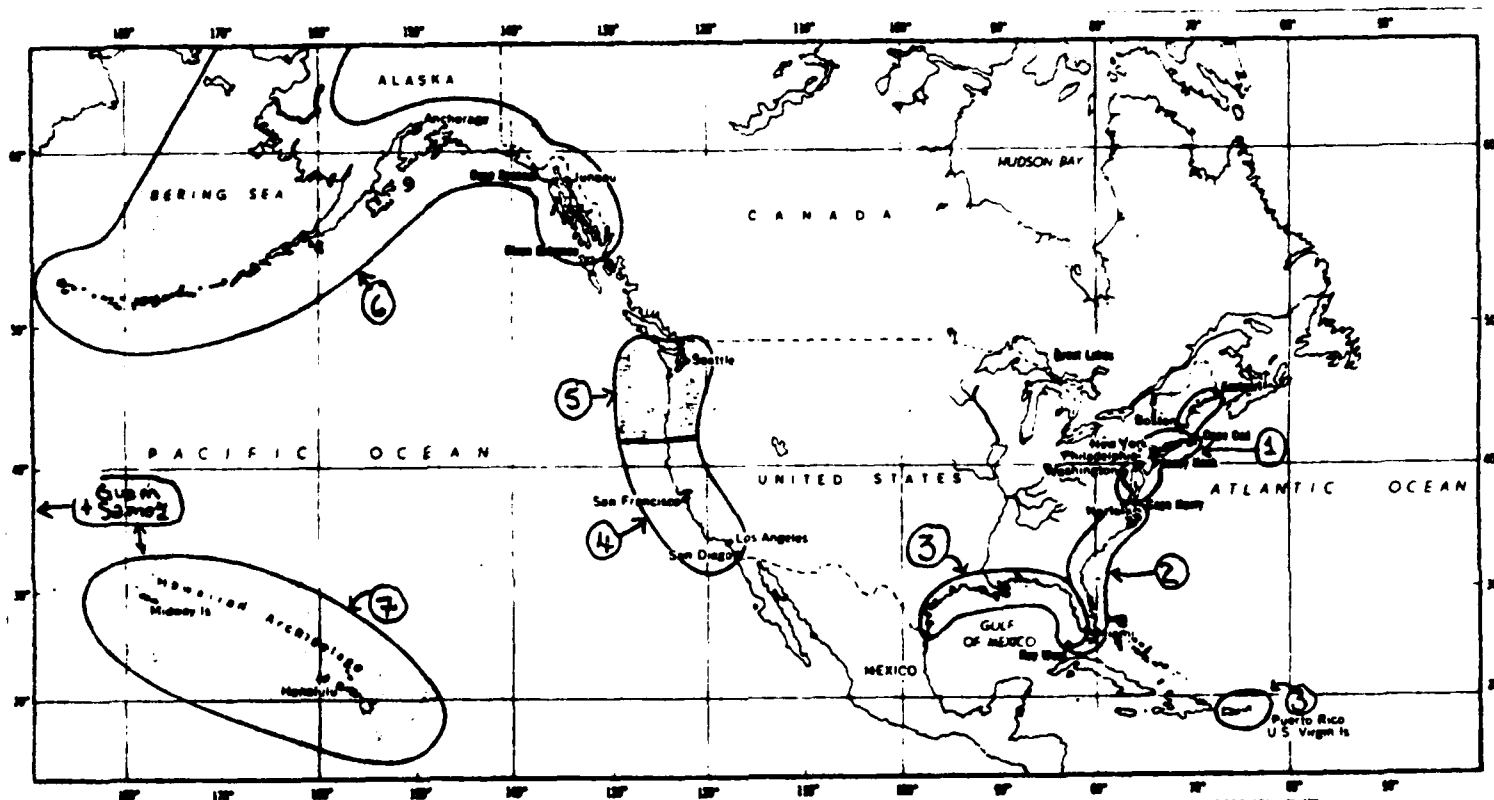
At least some degree of regionalization is needed for both the articulation of the sea use plan and for practical administration of its functional operations. The appropriate regionalization is a composite of both natural and policy features.

The current regions frequently used in terms of global differentiation are the first level and appear appropriate for planning/zoning purposes:

- 1) Upper Atlantic
- 2) Lower Atlantic
- 3) Gulf of Mexico and Caribbean Isles
- 4) Lower Pacific
- 5) Upper Pacific
- 6) Alaska
- 7) Pacific Islands

Figure 3-3 shows the general location of these sea regions.

FIGURE 3-3: U.S. SEA REGIONS (DERIVED FROM THE U.S. COAST PILOT, 1973)



The next regional structure is derived from the source and degree of "ownership"/control. The current demarcations and boundaries of such levels of "ownership"/control are complex and somewhat ambiguous. The following identifications can be made:

- Territorial waters extend three miles out to sea from the United States coast lines. These waters are under virtual "ownership"/control of the United States, except for innocent passage. Except where specifically designated as federal property, these waters are under state jurisdiction. In this study we also refer to these waters as "coastal" waters.
- The contiguous zone extends from three to twelve miles. In this zone United States "ownership"/control is limited to specific functions such as fiscal, immigration, sanitation, and pollution control. Other miscellaneous laws and regulations also apply here. We use the term "national waters" interchangeably with this.
- The fishery conservation zone is the area in which the United States claims "ownership"/control authority over fishery resources. This 200-mile zone also corresponds to that area specified by the Submerged Lands Act of 1953 in which the U.S. claims "ownership"/control of seabed resources out to 200 miles. In addition, the U.S. expresses economic interest in and lays claim to certain aspects of the ocean and seabed resources throughout this zone and to some extent beyond it.
- Other laws and regulations in which the United States claims certain rights of "ownership"/control which complement the above defined areas.
- International waters where "freedom on the seas" traditionally prevails or where the "rules of control and activity" are established via international institutions and mechanisms (currently beyond 200 miles).

Note that the generic degree of the source of ownership/control is the determining characteristic rather than the specific mileages. This is to emphasize the fact that our forecast suggests these lines of demarcation might change. In particular, the national waters are likely to be extended beyond the 12-mile limit and the economic control waters are likely to extend beyond the 200-mile limit.

Combining the above, we have a matrix situation as outlined in Figure 3-4

FIGURE 3-4: MATRIX FOR REGIONALIZATION OF SEA PLANNING AND ZONING				
	State Coastal Waters	National Waters	National Economic Control Waters	International Waters
Upper Atlantic*				
Lower Atlantic*				
Gulf Mexico/Caribbean*				
Lower Pacific*				
Upper Pacific*				
Alaska*				
Pacific Islands*				

* Each of these would have subheadings and lines for the activities outlined in the conceptual framework shown in Figure 2-1.

For purposes of access control, local sea zoning authorities would have further detailed geographic blocks, at least at the level of the latitudinal and longitudinal grids and probably a breakdown more fine than that, say in divisions of tens, i.e., 100 subgrids or 1000 subgrids or 10000 subgrids as the number, diversity and geographic features of the specific areas required. Note, however, that this is for purposes of access control and cataloging of activities occurring. It seems not feasible to consider these cataloged zones as detailing future activities to be permitted. Access proposals or requests would be individually evaluated to make the determination of compatibility. If one activity seeking access requires displacement of an existing activity due to incompatibility, then appropriate procedures for the resolution of the conflict will be evoked.

ORGANIZATIONAL PRINCIPLES

Several different types of management and operational functions are clearly implied:

- The overall process of strategic policy planning articulated through the integrated sea use plan.
- The various functional developmental and management tasks associated with the equivalent of economic sectors within the marine economy. These include marine agriculture (aquaculture), mineral resources, recreation, military, safety, law enforcement, environmental standards, and

research. In essence, each of the uses and subuses outlined within the conceptual framework in Figure 2-1 can be considered equivalent to a given digit level in a marine economy code analogous to the Standard Industrial Code (SIC) used by the Department of Commerce for the overall economy.

- The legislative process and regulatory/administrative processes which incorporate the legal structure to govern the sea uses and activities.
- The enforcement processes whereby adequate enforcement of the laws is brought about.
- The judicial process whereby rights of appeal and "due process" are afforded.
- Actual operations to conduct the activities.

The actors involved in the above processes encompass all levels of government and many institutions and individuals within the private sector.

Some organizational concepts and principles are therefore needed.

Organizational principle #1: The overall integrated sea use plan which is a comprehensive strategic policy planning instrument should be the responsibility of an organizational entity exclusively for that overall strategic policy planning role. This principle derives from a variety of reasons. The first is the principle that the functional managers having developmental responsibility are in such diversified technical and operational fields that there is no feasible way to consolidate them. Even if a single cabinet department were established, it would need to be subdivided along the functional lines of the technologies and industrial classifications. Accordingly, there is an unavoidable division/specialization of labor entailed among the functional management systems. This suggests that the functional developers are advocates for their functional areas of responsibility. Accordingly, an independent and neutral body would be needed.

It is our thought that such a body should be organizationally placed in a manner similar to the current Council of Economic Advisors, or the Council on Environmental Quality, both components of the Executive Office of the President.

Organizational principle #2: The various developmental, promotional and operational responsibilities should be divided in a logical fashion among functional specialties dictated by the substantive nature of the use, the technology, and the institutional structures for the subindustry/activities. This principle is not necessarily in conflict with the current advocacy among some for a Department of Marine Affairs or its equivalent. A cabinet level department would

be organized which would supposedly encompass all marine activities. As indicated in the above paragraph, even this type of departmental structure would require clear delineation of roles and responsibilities among various components.

Organizational principle #3: The sea use plan and the sea zoning process are interrelated, but they should be separated organizationally. The reasons for this are primarily related to the very difference in the nature of the roles and objectives of the two processes, the level of detail needed in the sea zoning functions, the technical expertise needed to establish the zoning standards and to develop an access control system which can effectively assess the degree of harmony and/or conflict between multiple uses in specific locales, and the much more operational nature of the process in terms of local geographic situations.

Organizational principle #4: The ultimate functional responsibilities for deciding upon standards and interactivity harmony/conflict with respect to total integrated impact within specific localized zonal grids should be a separately assigned function to a service agency not charged with the developmental/management responsibility as a resource manager. The independence is essential, the integrated responsibility is also essential in terms of understanding the synergistic effects of various activities within various locales.

This operational service agency also is a convenient mechanism for organizing development and maintenance of technical expertise required to make definitive safety assessments and establish the related standards.

Organizational principle #5: The functions of protection of life and property are service roles which should be consolidated within a single service agency or network of such agencies. Law enforcement is a common service feature. Arguments could be advanced, for example, that the Treasury Department should be responsible for enforcing the laws regarding contraband, the Justice Department the laws regarding drugs and criminal activities now within the Justice Department Role, the Environment Protection Agency should enforce the laws related to environmental protection, The Department of Interior enforce the laws related to mineral development and extraction, etc. But we believe the inefficiency and redundancy of effort which would generate from such a concept is sufficiently obvious as to obviate the need for further discussion.

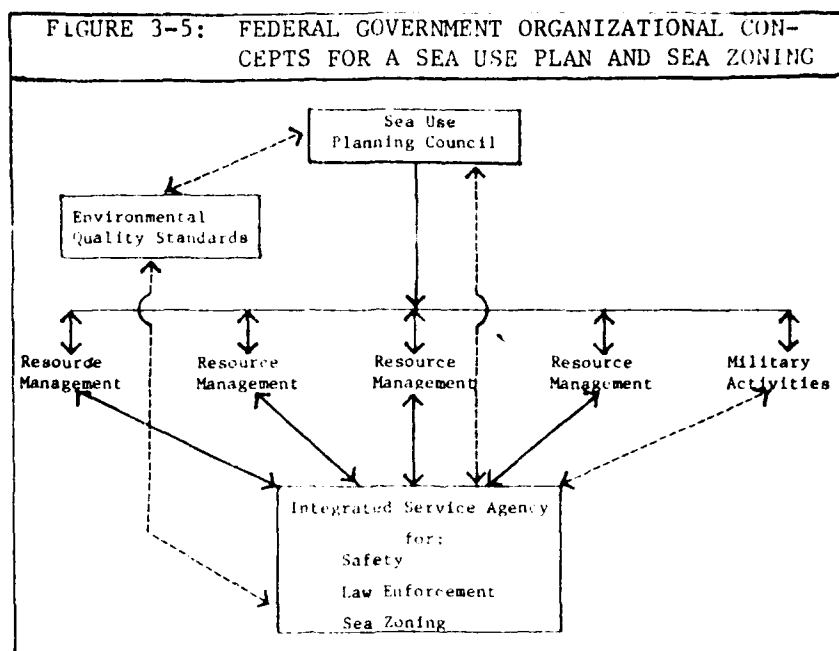
A single law enforcement agency is needed with the responsibility of developing and maintaining enforcement capabilities within the marine environment (in concert with responsible developmental managers and the overall sea use planning entity).

Organizational principle #6: The sea zoning processes, in so far as the federal government's operations are concerned, should be assigned to an agency which has focal operational responsibility and capability to be involved throughout the locales of the marine environment. Thus, the agency should have overall marine environmental responsibility in terms of geography and operational capability, in terms of being able to go to sites, etc. The agency should also have the coverage to effectively determine "use requirements" for specific sites, and to control the access to assure that only legal and safe activities are conducted.

Organizational principle #7: The nature of principles number 4, 5 and 6 above are such that these three principles should be embodied at the federal level within a single operational service agency. That agency should work with related counterparts of state and local agencies in so far as activities within the coastal waters are concerned.

Organizational principle #8: The responsibility for developing and promulgating environmental quality standards should be assigned to a central agency specially for that purpose. This stems primarily from the need for independence from both the problems associated with effective resource development management and with enforcement of laws and standards. To permit the standard developing process to become a captive of either mentality would be an obvious mistake. Organizational independence is one way to minimize such a risk. In addition, technical expertise is required. Finally, the environment does not accommodate our administrative desires and needs to simplify management tasks. The environment operates as a total ecology whether we wish it to be or not. The environmental quality responsibility should be aligned to coincide with this reality.

If we link all of the foregoing commentary, we can visualize an organizational concept for the federal government similar to that reflected in Figure 3-5.



PRINCIPLES/CRITERIA FOR ALLOCATING SEA USES AMONG VARIOUS ACTIVITIES

This section deals with the development of the various principles and criteria which should be used in allocating various activities.

Figure 3-6 summarizes the basic principles which should govern sea use allocations.

FIGURE 3-6: SUMMARY OF PRINCIPLES FOR ALLOCATION AMONG SEA USES AND ACTIVITIES

1. Principle of minimized control
2. Principle of resource management
3. Principle of multiple use
4. Principle of national goal achievement
5. Principle of access rights and due process
6. Principle of access control
7. Principle of security (safe and protectable)
8. Principle of military preemption
9. Principle of flexible allocation
10. Principle of localized evaluation/decision
11. Principle of precedent continuity
12. Principle of precedent override
13. Principle of preemptive use
14. Principle of environmental stewardship
15. Principle of conservation

It is clear that the principles do not lend themselves to a generalized set of highly definitive objective criteria which one can easily apply and get an acceptable/not acceptable answer of an unambiguous nature.

Rather, the underlying supportive criteria are a combination of:

- Specific conditions which should be met if the principle is to be fulfilled
- Specific features or considerations which are to be taken into account in the application of the principle
- Specific further subcategories which must be established in making the principle operational
- Specific and definitive "requirements" consistent with the more popular and conventional use of the term "criteria."

It can be seen that these principles and criteria weave together the various concepts and criteria developed in the preceding chapter. In this sense, they are mechanisms for effective execution. They are a bridge which begins to connect actual planning/zoning decisions and operations with related general concepts and criteria. This relationship and "bridging" function will become more evident as the principles and criteria are explained further.

1. The Principle of Minimized Control and Related Criteria

There are literally thousands of uses of the sea. This principle is meant to stipulate that the sea use planning and zoning processes will be applied to only those uses whose nature require such management attention. Every effort will be made to make this the smallest possible number of uses. Criteria for inclusion within the sea use planning and zoning systems are:

- 1) The activity is a significant component of national interest/need
 - a) It is directly or indirectly related to a defined national goal or objective vis-a-vis the use of the seas
 - b) It entails developing a supply for a resource:
 - On the critical materials list
 - Supportive of national resource independence
 - Potentially needed for export either as a world supply of a critically needed material and/or as a means for earning needed foreign exchange

- 2) The activity entails threats to the safety of lives and property
 - a) Due to incompatible activities being located too close together
 - b) Due to incompatibility of local environmental circumstances and natural features/conditions
 - c) Due to faulty operation of equipment or incompetent personnel

2) The Principle of Resource Management and Related Criteria

The sea is viewed as a national resource, or more appropriately as a network of national resources. A positive philosophy of resource management makes a significant difference to the approach to sea uses.

The sea is no longer to be ignored or considered a relatively small or unimportant dimension of the nation's natural resources heritage. Rather, it is to be approached from a positive concept of resource development, resource management, and resource conservation. Such approaches are far different than the perspective, "it is out there to be used as we must or as we wish."

Indeed, it is from this principle that the very concepts of need for a sea management system and a sea use planning system are derived.

Criteria involved in the resource management principle are:

- 1) The use/activity must be defined in a manner which provides positive identification of the resource being developed. This is not limiting, because under this principle every use of the ocean is considered to be the use of a resource. Even conservation of a natural state is a resource; i.e., the development of a means for assuring that we retain for this and subsequent generations the resource of a natural state, balanced with other resource development alternatives.
- 2) A resource development strategy/plan and responsibility will be assigned a definitive resource "manager" if:
 - a) There is need for an incentives program to stimulate development
 - b) There is need for operational development by government
 - c) There is need for specialized functional control of a naturally evolving development.
- 3) The resource development potential will be defined to the degree feasible.
- 4) There will be a definitive strategic assessment of the overall implications of the resource development, including its implications for other areas of the national economy, the international economy and the other resource development alternatives within the marine environment.

3. The Principle of Multiple Use and Related Criteria

The allocation of uses of the sea will be pursued in a manner which takes advantage of the potential for multiple uses that would occur within the same geographic context. In general, single purpose or highly restrictive use allocations will be made only when absolutely necessary.

Criteria for applying the principle of multiple use are:

Uses/activities will be classified into one of the following basic classifications.

- a) Exclusively restrictive uses/activities: those activities which are of such a nature that they preclude any other use within a specified proximity. An example of this might be a specialized cargo. The justification for this would be the extreme risk of catastrophic damage should a "blow up" occur in waters where surrounding activities were taking place. Another example might appear in a natural conservation area, in which absolute restriction to that use is essential to the very essence of the activity itself.
- b) Primary uses/activities: those activities which are most compatible with the environmental features and characteristics of a locale and which will normally be given precedence over other activities therein.
- c) Mixed restrictive uses/activities: those sets of activities which can be combined into complementary sets within a given locale under given technological and/or operational circumstances but which, when so combined, generally preclude other uses except on an as-possible basis. An example might be the delineation of an area for an energy power generation center/industrial complex floating offshore which will be of a scale and nature likely to be restrictive of at least some other activities.
- d) General purpose use/activity areas: those areas which can be designated at least for a time as not controlled, i.e., they are available for any use without the need for access control. (Note: for now we see no entries in this category for any activity meeting the conditions of minimal control. However, it is included here for conceptual completeness.)

4. The Principle of National Goal Achievement and Related Criteria

The allocated uses of the seas will be directly or indirectly connected with the achievement of associated national goals. This is consistent with the concepts of resource management, which inherently are goal-oriented.

Criteria for applying the principle of national goal achievement are:

- 1) Ascertain the linkage between the proposed use/activity and the national goals and objectives vis-a-vis uses of the sea, overall economic development, and/or quality of life.
- 2) Define the specific nature of the benefits and quantify them in so far as is possible. Quantification may include numbers of persons realizing some form of individual or institutional goal fulfillment related to the national goals/objectives structure; numbers of jobs, level of economic activity/value and other such traditional measures.
- 3) Determine the implications (positive or negative) for other areas of national life. For example, to what degree will resource development of the marine environment displace employment within the land based part of the national economy.

5. Principle of Access Rights and Due Process and Related Uses

The seas are a public resource. Accordingly, every individual/institution is entitled to equal rights of access to the seas, and can be deprived of such rights only through good faith application of the due process of law. Denial of access is accompanied with a process of right of appeal to the judicial system.

Criteria for application of the principle of access rights and due process are:

- 1) All citizens and domestically chartered institutions have equal rights to petition or propose that they be granted access to any given area for any lawful purpose.
- 2) There will be a clearly defined procedure showing under what conditions access is controlled, and what procedures should be followed in order to acquire the authority of access.
- 3) Foreign individuals and/or institutions will be granted access on a special basis. There is no responsibility to guarantee them rights of access within the waters we are concerned with here, except in certain instances of the right of passage.
- 4) An effective appeals procedure/route will be established which will provide for ultimate disposition of disputes in appropriate judicial processes and jurisdictional units.

6. Principle of Access Control and Related Criteria

For those activities designated as within the scope of the minimal

control principle, and hence subject to control, there will be an effective process for control of access, assuring that activities are pursued only by authorized persons under authorized conditions.

- 1) For those uses and activities which are defined as coming within the system there will be a definitive system of control through licenses and/or special use permits or some other appropriate form of administrative authentication.
- 2) Procedures will be in effect to determine that the persons granted access have met the qualification for such access, and that their activities can be expected to be in compliance with safety standards and other legal or regulatory requirements.
- 3) A definitive set of operator standards will also be maintained as a means for determining propriety of granting the access requested.
- 4) A system of surveillance will be maintained to assure that the access controls are complied with, that no unauthorized use/activity is occurring and that no authorized activity is being conducted in a manner which violates the terms and conditions of the access authorization.

7. The Principle of Security and Related Criteria

Persons operating within the marine environment have a right to expect that the access controls will be practiced in such a manner as to afford them the maximum feasible safety from harm brought about by the actions of others or by nature. This concept of safety/protection includes both their life and their property.

Criteria for application of the principle of security are:

- 1) Developed sets of definitive safety and security standards which will define the various requirements and affix responsibility for the fulfillment of such requirements. For example, equipment performance standards and density standards, proximity standards for activities in partial or total conflict with one another, operator qualifications and standards, etc.
- 2) A system of inspection to determine that the standards have not been violated.
- 3) A process for holding violators responsible for their actions including removal of access rights if appropriate.
- 4) A procedure to assure all parties concerned that due process for unsettled disputes will be handled through appropriate judicial proceedings.

This is an extraordinarily complex set of criteria to develop. Setting security standards will have profound impact upon whether or not many activities are economically feasible, and whether or not normal nonspecialized professionals can engage in the activity. For example, rigid equipment performance standards may be imposed for submersibles in order to minimize the costs and problems of search and rescue, of collision, and of other forms of damage. Very wide spaces may be required between certain activities as a means of reducing the vulnerability to damage through dispersion.

8. The Principle of Military Preemption and Related Criteria

The seas are not only a locale for the military operations of the U.S., they are also available to other nations including potential enemies of the United States. It is important to know to what degree such military capability is present or emerging. Such an intelligence capability may require specific rules for who can operate where, under what conditions, and in what types of equipment.

In addition, there is the need from time to time to set aside areas of the sea for military training and maneuvers. Such requirements will receive the needed preemptive status.

Finally, in times of war or national emergency the military operational requirements may take precedence over otherwise authorized activities.

Criteria related to the principle of military preemption are:

Military preemption will be granted only under circumstances which have clear and direct relationship to the national military needs. This will include defining areas in which:

- 1) Activities need to be curtailed in order that the presence of foreign vessels/military capabilities might be monitored. This is particularly applicable to the underwater areas.
- 2) Military training or other operations have a need to take place. This need may have been established under the principle of precedent continuity. Present military bases and training areas are closely associated with fixed investments not readily mobile.
- 3) Direct military operations are necessary in times of emergency or conflict.

9. Principle of Flexible Allocation and Related Criteria

This principle acknowledges the reality that there is no feasible way now (nor in the foreseeable future) to publish a definitive set of detailed "do's and don't's" associated with specific zones as a part of the overall sea use plan or even of the sea zoning process. Rather, the concepts must be flexible to permit various activities to occur which might otherwise appear in conflict because of the local circumstances, the particular form of technological applications, and other variables.

10. Principle of Localized Evaluation/Decision and Related Criteria

As has been pointed out previously, specific use authorizations must be granted with definitive knowledge of the site-specific conditions and activity plans. This principle does not refer to the level of government where the control authority rests. In coastal waters it may be with state or local governments or with appropriate regional authorities. In other waters it may be with the federal government. The concept has to do with locale and not with the specific governmental entity having jurisdiction.

Criteria related to application of the principle of flexible allocation and of localized evaluation/decision are:

- 1) There must be an operational agency whose responsibility is the actual granting of the access for a proposed use/activity.
- 2) That agency must have the capability to go on-site and to know the total conditions of the site. For purposes of access control, the sites will be specified in some form of appropriately detailed grid.
- 3) The flexible principle will mean that no total blockage of an activity will be defined (except under conditions of exclusively restricted use). Rather, various specific forms of technological applications will be evaluated to determine the full integrative effects of their actions.
- 4) In coastal waters, such agencies may be state or local governments. However, there should be a general overall coordinating federal agency.

11. The Principle of Precedent Continuity and Related Criteria

This principle stipulates that once an activity has become established within a given locale, the actors within that activity have the right to presume that they will not be blocked from its continuation unless the conditions under which they gained access were conditional and expressly of a temporary

nature. It also provides that if alternative uses are approved and the actors in the precedent activities have a "good faith" performance, some form of compensation is proper for damages which they may sustain by being preempted on behalf of another activity.

The concept of sunk costs, and the right to reasonable assumptions of continuity associated with the requirement to have pay-back from such costs are accommodated in this concept.

Finally, as was noted earlier, there has been a long-time form of sea use allocation and zoning of sorts. Ports, beaches, resort areas and offshore facilities are already established, traditional fishing grounds are known and marked. All of these evolutionary patterns have a deterministic influence on the sea use plan. Barring extraordinary circumstances, a principle of continuity should prevail for activities already in being.

Criteria for application of the principle of precedent continuity are:

Actors within a given locale will be granted the rights of precedent continuity if:

- 1) They have a "good faith" reason for having believed they would have continuous access, and if they have a meaningful vested interest in being allowed to continue.
- 2) They have been granted license or access/use permission which contains no stipulations as to the temporary nature of the authorization.

An actor may, in due process, be preempted from his right of precedent continuity. When that occurs, there may be procedures whereby he can be granted damages or some form of recovery for his losses. (See the subsequent paragraph on precedent override or displacement.)

12. The Principle of Precedent Override or Displacement and Related Criteria

Despite the above principle of continuity, there will be clear instances when the overall public interest or national objectives are much better served if precedent uses are displaced by admission of a new and perhaps conflicting activity.

There should be clear procedures for such circumstances.

Criteria for application of the principle of precedent override or displacement are:

Under some circumstances precedent override or displacement can and will occur. In general, these conditions will be minimized. The decision will occur under the following conditions:

- 1) There is a clearly greater national/public benefit to be derived by the displacement.
- 2) There is no reason for the incoming activity to remove the conflict by application of a different form of technology to achieve the same basic objectives.
- 3) The conditions of due process for the rights of all actors holding precedent continuity rights are observed. These may include calculation of the damages to these actors and appropriate reimbursement or payment to them for the effects of the dislocation. Guidelines will need to be developed to determine under what conditions the government will cover the damage and under what conditions they will be included as a cost of development to the incoming actor.

13. Principle of Preemptive Use and Related Criteria

This principle recognizes that an activity approved after the sea use planning process and sea zoning take effect will tend to narrow the degrees of freedom in future alternative uses. This is especially true in light of the precedent continuity principle discussed above. Once an activity is approved it will acquire precedent continuity privileges/rights. Thus, all new activities being granted access should be evaluated carefully in terms of the preemptive character they will influence upon future alternative uses.

Where the preemption is judged to be inconsistent with the overall sea use plan and the national interest, grounds for preclusion of the activity will probably exist. In other instances, the authorizing procedures should stipulate the temporary nature of the permission, so as not to pass on full precedent continuity rights.

Criteria for application of the principle for preemptive use are:

In order to fully evaluate the implications of access it is necessary to determine the degree to which a proposed use preempts other uses. Factors to be considered are:

- 1) The degree of fixed costs and facilities involved in the proposed activity.
- 2) The nature of the activity in relation to other potential activities within the specific zoning grid or locale concerned.

Several things are needed to make such assessments:

- 1) An inventory of the resources involved in the locale.
- 2) A sound activity forecast of the future technological, economic, political and social developments which will give rise to alternative potential uses.
- 3) A means of assessing the relative benefits of the proposed current use against future potential uses.

To the degree possible, the current use will be authorized in a manner which will minimize the future conflicts. If a future precedent override is expected, then the use authorizations will be designed to provide fair treatment but minimal residual precedent rights for the interim users.

14. The Principle of Environmental Stewardship and Related Criteria

Responsible resource development maintains a highly conscious recognition of the environmental consequences of the uses of the seas. Environmental qualitative standards and controls are the mechanisms whereby man governs himself in a manner which does not permit unacceptable or unnecessary violation of the natural environment.

Criteria for application of the principle of environmental stewardship have been generally described already. The basic need is for a set of environmental quality standards together with sound assessments of the environmental implications of the proposed use/activity.

15. Principle of Conservation and Related Criteria

As resource development takes place the importance of responsible conservation policies is also paramount. Some areas should be set aside as natural areas which will not be permitted to be disturbed by the resource development. In this sense, the "natural areas" are themselves national resources which must be developed and/or managed for nondevelopment in order to preserve the overall balance of the goal network.

Criteria for application of the principle of conservation are that there will be conservation areas clearly demarked in such a manner as to:

- 1) Provide for sea conservation areas which are adequate to provide needed undisturbed "sea wilderness" or "natural areas"
- 2) Assure that any multiple uses--such as recreational diving--are fully compatible with the conservation potential.
- 3) Assure that adequate conservation areas are set aside for the continuation of fundamental research on the ecology of the oceans.

Summation

It is clear that the above principles create a mixture of informational needs, administrative mechanisms and specific conditions to be met. The common thread is that they describe things which are necessary for effective application of sea use/activity and allocation.

The concepts and criteria discussed in Chapters 2 and 3 are complex and somewhat abstract. It will be helpful to walk through an illustration to see how the procedures might work. This is the subject of the next chapter.

CHAPTER 4: TOWARD AN INITIAL SEA USE PLAN/SEA ZONING PROCESS

This chapter outlines additional principles involved in the development of a sea use plan and sea zoning process. It then illustrates the application of these principles and processes plus the preceding general concepts.

The additional principles involved are:

- Defining the appropriate level of detail for uses to be defined in the sea use plan. (15 primary uses)
- Developing specific planning objectives for each of the sea uses appearing in the plan. (46 planning objectives)
- Developing criteria for how to make allocations among uses both within the sea use plan and the sea zoning process.

After these additional principles are developed, an illustrative sea use plan and sea zoning process is outlined.

DEFINING THE APPROPRIATE LEVEL OF DETAIL FOR THE SEA USE PLAN.

One of the most important elements in the practicality of the sea use planning concept is the determination of the appropriate level of detail which the sea use plan will contain.

The regionalization concept developed in chapter three begins this definition by outlining the seven basic regions for which plans could be developed and within which the zoning process could be administered.

The level of detail to be incorporated within the sea use plan is affected by the defined roles/objectives of the plan itself. It is to be a strategic policy document which remains above inordinate details.

The concepts of minimal control and multiple use also affect the level of detail. Only those uses which are essential to control should be included. In addition, the plan should not preclude any additional uses which are not incompatible with one another. These two concepts introduce a complex series of issues with respect to the appropriate level of detail to be included in so far as specific sea uses are concerned.

In this section, we outline our view of the appropriate level of detail to be included by developing a list of the specific sea uses which should be defined within the sea use plan.

The first step in the process is the development of the concept or principle of primary use. This principle limits the uses which are required to be put into the sea use plan. The second step in this definition of detail is to blend the activities listed in Figure 2-2 into a listing which specifies the specific level of uses/activity to be defined and allocated as primary uses

within the sea use plan.

The Principle of Primary Use.

It has already been emphasized that any given column of sea space from beneath the bottom to the surface and above may support a complex network of simultaneous uses with complete harmony and compatibility. Moreover, these compatible uses may vary from locale to locale on a highly differentiated and individualized basis determined by the nature of the natural environments, the technologies employed in each activity and the density/intensity of each activity.

It is clearly impractical to attempt to define all possible activities for each column of sea within either the sea use plan or the sea zoning process. Accordingly, the principle of positive definition of key primary uses will be employed with the sea use plan. This means that for each of the planning regions, the various activities encompassed within this region will be grouped into a series of primary uses which are then allocated with the sea use plan to receive priority rights vis a vis general areas within the region. In making these planning allocations, consideration will be given to the relationships between the natural environment and the use. For example, oil exploitation can only occur as a primary use where there is oil. This will be designated as the planned primary use and it will receive priority over other uses. All activities proposed to be conducted within the given area will be evaluated in terms compatible with the primary use.

Defining the Primary Uses to be Stipulated within the Plan.

Figure 2-2 outlines the conceptual structure for sea uses and activities which are forecast to the turn of the century. The distinction between uses which are defined by motivational objectives and activities which are specific operations is discussed in the rationale for the development of this conceptual structure (see Chapter 2).

In our view, all activities listed within Figure 2-2 meet the conditions for inclusion in the planning/zoning process under the concept of minimal control. However, the sea use plan does not need to define each activity. To do so is both unnecessary and impractical. Activity control (in the sense used here) is more appropriate to the sea zoning process. By the same token, the eight basic motivational uses do not appear sufficiently detailed to provide operational guidance in the sense of primary uses.

A special list of primary uses to be included and specifically allocated within the sea use plan is developed and summarized in Figure 4-1. There are

no hard and fast rules which make this the only correct level of detail for primary uses. However, we believe that it is as consolidated as it can be and still achieve the objectives of the plan. Likewise, it is our judgment that further additions would simply carry the plan to a lower level of detail than is necessary.

FIGURE 4-1: LIST OF PRIMARY USES TO BE SPECIFICALLY
LOCATED WITHIN THE SEA USE PLAN

- Use as a medium for military activities
- Use as a medium for conducting antisocial and criminal activities
- Use as a source of living resources into the economy
- Use of the natural forces of the oceans as a resource
- Use of seawater as a source for minerals and/or as a product in its own right
- Use as a source of resources on and under the seabed
- Use as a waste disposal system
- Use as a medium for port operations
- Use as a medium for moving vessels
- Use of fixed transport systems
- Use for human habitation
- Use for siting industrial operations
- Use for recreational and aesthetic purposes
- Use for aesthetics and natural states
- Use as a medium and object of research

DEVELOPING SPECIFIC PLANNING OBJECTIVES FOR EACH PRIMARY USE

For the plan to be constructed, it is necessary to have more detail vis-a-vis the specific objectives which are to be sought in assigning/allocating sea space among the various primary uses. This section develops an initial set of such objectives. There are 46 specific planning objectives. The relationship to the primary uses listed in the previous section is shown by insertion of the primary use as a marginal caption.

It should be noted that not all of the primary uses are representative of a resource which would be positively developed as a matter of national objectives. For example, the government would not develop the potentiality of the sea as a medium for the conduct of antisocial and criminal activities. Rather, this potential use is to be taken into consideration from the standpoint that it affects the patterns and techniques of resource development policies such that those policies minimize the potential for this use of the seas.

Likewise, our government would not develop the potential of the seas as a threat to our security because they can be the medium for aggressor nations to operate their military capability. Rather, we wish to minimize that potential. However, the potential too has an important effect upon the resource development strategies and hence upon the sea use plan and zoning.

The specific planning/developmental objectives to be sought vis-a-vis each potential use help to clarify these situations.

Planning Objectives Related to Use as a Medium for Military Activities

The sea can be used for the military activities of both the U.S. and potential adversaries. Planning objectives must consider both of these groups.

1. To assure the capability to know the extent to which other nations have a military capability operational in the waters within the planning/zoning system.
2. To assure that the marine resource development patterns are involved with a civil defense orientation in mind.
3. To provide the needed space for essential facilities and training needs for the U.S. sea-going military capabilities.
4. To provide needed operational space and contingency plans for activities within the marine environment in conditions of national emergency up to and including general warfare along the spectrum from conventional to nonconventional.
5. To adapt, in so far as is possible, the military needs to areas where there is minimum interference with civilian development.

Planning Objectives Related to Use as a Medium for Conduct of Antisocial and Criminal Activities

6. To have patterns of offshore development which minimize the potential for damage that can be injected through application of antisocial technologies.⁽¹⁾
7. To have minimal means whereby the sea can be used as the medium for introduction of antisocial devices or groups into the U.S. land environment.
8. To have an effective means for deterring antisocial behavior and crime in, on, or above the seas.

(1) For an extensive discussion of these technologies and the potential they have for disruption of the marine economy see: Future Underwater Activities and their Implications for the Coast Guard Circa 1978-2000. C. W. Williams, Inc. May 1978, U.S. Coast Guard Contract DOT-CG-73571-A.

Planning Objectives Related to Use as a Source of Living Resources

The living resources potential includes both animal and plant life and involves the management and harvesting of such life systems for purposes of food, energy, and as raw materials for various other products.

9. To develop and manage the seafood production potential of the waters included in the planning area both for purposes of the domestic economy and as an export potential.
10. To employ the foreign fishing rights/quotas as a means of export revenues to the degree feasible, rather than concentrating upon limitation to preclude depletion of stocks. (Note: This objective relates to the judgment that effective resource management will greatly increase the potential seafood production and that such potential will provide aquacultural surpluses somewhat analogous to our current agricultural surpluses. Those surpluses will be needed in the future U.S. economy for foreign exchange to finance required material imports.)
11. To develop an appropriate sea plant culture industry for this renewable nature-of-the-seas resource.

Planning Objectives Related to Use of the Natural Forces as a Resource

The natural forces which occur within the seas are being perceived as major potential energy sources. Technological concepts already outline how such infinite forces can be harnessed to produce electricity--the general purpose energy. It is this dimension of the natural forces which defines them as a resource within the time frame of this analysis.

12. To develop the natural forces of the sea as a means for energy to such a degree as to provide the basic capability to free electrical power from reliance upon any single source which places the U.S. in a dependent situation with other nations.
13. To tie this offshore electrical generation system into the land based national grid such that it may be used to supply all areas of the nation.

Planning Objectives Related to Use of Seawater as a Source for Minerals and/or as a Product in its own right

In the context of this section, the seawater is a resource because it contains minerals and other materials which have value when extracted and concentrated and also because water itself is a commodity if it can be converted to useable quality.

14. To develop the resource potential of various minerals and materials within the water by developing economically feasible extraction technologies and industrial uses.
15. To develop techniques for converting sea water to a useful commodity in its own right. To use this resource to alleviate the forecasted problems associated with the growing shortage of fresh water from the land-based hydrological system.

Planning Objectives Related to Use of Resources on and under the Seabed

16. To develop the supply potential of the seabed and underseabed as a mining industry for supply of materials needed within the domestic economy and for possible export.

Planning Objectives Related to Use as a Waste Disposal System

For years the sea was used as a place to indiscriminately dump wastes or to receive runoffs without regard to what was going in or the effects it was having. For many decades these practices were accepted because the capacity of the sea to absorb these wastes had not been stretched. The evolution of the environmental crisis has resulted in some potential misperceptions of sea uses. Concentration today has become centered upon keeping all foreign materials and wastes out. Injections are almost automatically assumed to be pollutants with the further connotation that a pollutant is an undesirable factor to be prevented.

There is need to make more explicit the role the sea can play as a natural waste disposal system. Positive management of national resources will help in reducing the problems of waste and in possibly stimulating the productivity of the sea, particularly as it involves absorption of nutrients which can increase the production of seafoods and useful plants.

17. To develop the positive waste disposal capability of the seas with the viewpoint of encouraging the deposit of wastes in selected areas which will increase the productivity of the marine economy.
18. To define the capacity of the system to accept other wastes which it can process in an acceptable period of time by virtue of the biological/chemical interactions of the ocean environment with the waste materials.
19. To develop appropriate quality standards to preclude undesirable pollution and injection of foreign elements as a consequence of man's activities.
20. To develop effective ways to enforce the waste disposal standards including those which prohibit injection.

Planning Objectives Related to Use of Port Operations

In this context port operations are considered to be any place where one joins the activities of the sea with the activities of the land in terms of commercial transportation. Thus, the points into which pipelines come in from the sea are also ports, as would be points of entry to shore for cables that transport either communications or electricity. Of course the traditional ports where ocean-going vessels can dock for unloading, offloading, and repairs and maintenance are also included.

21. To permit the existing port network, as an important element of local economies, to continue at levels which will not impair those economies.
22. To develop special safety features for the handling of hazardous materials and cargoes. Those materials considered to be especially dangerous will be handled in more remote facilities which are designed for that purpose and which will limit damage if a catastrophic accident occurs.
23. To permit port operations to evolve in a manner which provides for maximum intermodal efficiencies between the ocean-going and the land-going distribution systems. Pipelines directly from sea-based mining operations or offshore ports directly into processing centers and/or land-based pipeline systems are the example at one end of the spectrum. Modular containerization with automatic warehousing principles applied to the vessel with automatic offloading of containers and direct placement upon appropriate land-based carriers is another.
24. To develop offshore ports with the viewpoint of making more economically feasible concepts of "super ore carriers" as well as super tankers in order to provide needed efficiencies to help offset the consequences of the growing need for the U.S. economy to import raw materials into its basic industries from extraction industries located in other lands. The need to offset the disadvantages of additional bulk transportation costs are important to the continued economic competitiveness of the basic industries within the domestic economy.

Planning Objectives Related to Use as a Medium for Moving Vessels

25. To develop ocean highways in such a manner as to provide no limitations or barriers to the needed degree of transportation, including the expected significant increase in the tonnage of commercial transport.
26. To permit transportation patterns which do not impede the growth of desired recreational areas both on the surface and beneath the surface.

27. To adequately absorb and accomodate security standards within the transportation/traffic patterns.

Planning Objectives Related to Use of Fixed Transport Systems

The fixed transport systems include systems to connect land areas separated by the sea, such as the proposed tunnel under the English Channel, causeways across areas of the Gulf and other locations connecting offshore islands with a continent or connecting different points on a continent via more direct routes. Fixed systems also include cables for messages or electricity and pipelines for transport of liquids and solids reduced to slurry. Semisolids or heavy materials transported through pneumatic tubes are also part of a fixed transport system.

Some of these technologies are still in the future, but they need to be adequately considered within the sea use plan.

28. To develop pipelines which will maximize the flow of materials extracted from the offshore operations into land-based processing plants or direct distribution systems.
29. To pattern the pipelines in a manner which will provide minimum interference with the other potential uses of the sea.
30. To develop electrical grid systems which will permit the offshore electrical energy to be converted and distributed directly into the national grid.
31. To develop other fixed structures for transportation of people, materials, or equipment to the degree the marine- and land-based economies show a need. (NOTE: These are not yet defined within our forecasts and analyses, so we make no effort to delineate what they might be. Others no doubt will be able to fill this gap.)

Planning Objectives Related to Use of the Seas for Human Habitation

Human habitation of a long-term duration in other than traditional naval vessels is a factor in the future of the marine economy. However, we do not expect major sea cities or population centers to grow within the time frame of this study. Several potential sites which appear especially attractive for such development might be earmarked and reserved in the plan for such an eventuality. However, there will be a variety of lesser habitats largely related to housing the personnel directly involved in offshore operations.

32. To develop a series of acceptable modular habitat concepts for use on the sea bottom, in a submerged state, or on an ocean platform similar to the floating island concept.

33. To begin to develop the needed production/equipment standards associated with such habitats in order to provide sound guidance as the industry emerges.
34. To build into sea use plans the concept that some activities will entail ancillary habitats, and to provide for the ambience needed.

Planning Objectives Related to Use for Siting Industrial Operations

As the resources of the sea are developed, related industrial processing operations will become increasingly economically feasible. Many such processing facilities are creating such difficulties within land environmental management that it is not unrealistic to project a "flight to the seas." The types of facilities most likely to emerge are those refineries related to offshore oil and gas extractions, high energy-intensive processing plants which can directly use the energy converted from the ocean forces, various food processing plants in the area of the food harvesting, and various other activities which for one reason or another find advantages to the offshore environment. Nuclear power plants, for example, might become more acceptable to the antinuclear forces if they were located out at sea.

35. To incorporate into the sea use plan the concepts of industrial areas which can accommodate the growing potential and economic advantages as well as social advantages of location of certain industrial operations offshore.
36. To develop definitive standards and concepts for the type of industries that are acceptable under various circumstances, and also to determine the appropriate operational and equipment standards.

Planning Objectives Related to Use for Recreational and Aesthetic Purposes

Recreational resources which are based upon features of the natural environment are a long standing tradition within concepts of the recreational industries.

37. To assure adequate space allocations for recreational purposes.
38. To develop an appropriate sea parks program and network as a combination recreation/conservation program
39. To provide for the evolution of underwater resort facilities in areas of unique value.
40. To provide for a program to demark unique recreational areas by natural features and to restrict these areas from impairment.

Planning Objectives Related to Use for Aesthetics and Natural States

41. To develop a program similar to the historic landmarks, which will set aside areas of unique beauty and interest for protection as conservation or for sea wilderness areas.
42. To develop standards of aesthetic quality for sites near inhabited areas and to use the standards in devising sea zoning and access control systems.
43. To follow a general principle that aesthetic quality will remain undisturbed except when reasonable technological alternatives do not exist to achieve that objective, and when the sea uses are justified otherwise.

Planning Objectives, as a Medium Object of Research

44. To continue research programs to map, as expeditiously as is feasible, the natural features of the sea, including the inventory of its resources.
45. To launch research programs to enhance the economic utility of the sea's resources to find new processes which can permit value to accrue to currently noneconomic resources including the marine animal and plant life as well as the inorganic materials of the ocean.
46. To sustain sufficient research to evaluate the overall effects of activities within the marine economy, and otherwise to connect that research with overall scientific advancement.

CRITERIA FOR ALLOCATION AMONG USES WITHIN THE SEA USE PLAN AND SEA ZONING PROCESS

The final need is for some set of governing criteria for prioritizing the allocation among various sea uses and activities which are in conflict with one another within the same area. An initial set of such criteria is outlined below:

- 1) Currently entrenched activities will be given a high priority for continuance under the principle of preceding continuity. This will be particularly true of those activities connected to extensive fixed capital investments or other vested interests which are not mobile or geographically flexible to be relocated as needed.
- 2) Those uses requiring unique natural features will normally be given priority in those areas where such features are found--assuming no other conflicts. In the event of other conflicts, additional criteria will be applied.
- 3) If a use is "geographically mobile" and can be assigned to a wide variety of areas, it will normally be allocated to an area not associated with uses requiring unique features or other special locational considerations. In essence, the geographically mobile use will be given lowest priority for primary use designation if other uses requiring special considerations are involved.

- 4) In addition to geographic mobility, the overall number of areas available for pursuit of a given use will also be considered. If some activities have very specialized requirements and can occur in only one or a very limited number of places, then the primary use for that activity in those places will receive priority. If, on the other hand, there are a large number of places where the use can be pursued, then it will receive lower priority in cases of conflicting possibilities.
- 5) Commercial transportation channels will receive needed priority to assure adequate and safe transportation. Such channels will be used as both a means of traffic control, enforcement of laws and facilitation of inspection/surveillance. Transportation channels will also be designed to keep the underwater areas for commercial and nonmilitary activities. Military training or other operations conducted within the U.S. waters should be minimized.
- 6) Technological adjustments and adaptations may be required to resolve conflicts among desirable primary uses.
- 7) Sea-based resources which provide relief for items of the critical lists will be given developmental encouragement.
- 8) Resources which are an important element in either the national or international economy--such as food--will be developed as subsectors of the marine economy with priority motivations.
- 9) Resources which facilitate national material independence will be given priority.
- 10) Resources which will enhance economic development without displacement of land-based economic patterns will be encouraged.
- 11) Resources which will offer competition with and require a substitution for land-based domestic economic activities will be evaluated to determine the net public effects, costs and benefits.
- 12) Resources which are not positively associated with national goals and objectives will be permitted on an "as appropriate" basis, but without the benefit of positive incentives or governmental leadership.
- 13) Adequate areas will be set aside for conservation purposes.
- 14) The sea as a resource for positive waste disposal and management will be developed and evaluated against the other waste management potentials

DEVELOPING AN ILLUSTRATIVE SEA USE PLAN.

The specific operational details required to develop an actual "ready to launch" plan are beyond the scope of this effort. However, it is possible to illustrate how the above concepts and principles might appear when applied to a given sea use plan.

The specific steps to be executed in developing the sea use plan are:

1. Division of primary uses into three sets:
 - a. Those requiring specific/unique natural features
 - b. Those not necessarily requiring unique natural features, but which are most appropriately allocated on some set of specific criteria
 - c. Those generally assignable to most waters within the region
2. Determine initial use allocations based upon current use patterns
3. Overlay of the potential primary uses based upon geographical/environmental requirements that are use specific
4. Determination of primary use priorities and allocations for uses geographically/environmentally limited
5. Determination of the remaining primary uses suitable for the region and development of planned use allocations for them
6. Determination of nondesignated or general purpose areas for which no primary allocations will be made

In Figure 2-2 the various forecasted uses and activities are classified into the three sets outlined as step 1 above. The purpose of this step is to provide an initial relationship between those activities which are geographically constrained and those which are not. Priority for geographically constrained uses will be granted on the basis of these requirements.


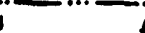
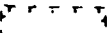
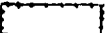
Since current use patterns are to receive special priority consideration they need to be plotted on the regional map first.

The uses to be chartered can be assigned a legend for purposes of identification. (see Figure 4-2). This legend was derived from analysis of actual operations currently found in these two regions. There are several additional uses not assigned a legend code and not included within this illustration. They include:



- A number of marinas along the coast especially in protected areas from Maine through Virginia
- Submersible activities for research, photography, inspection, tests and training
- Recreational diving which occurs at wrecks and numerous other locations near the coasts

FIGURE 4-2: LEGEND FOR "MAPPING" CURRENT SEA USES


MEDIUM FOR MILITARY ACTIVITIES

-  Submarine operating area
-  Pacific missile range
-  Naval restricted area
-  Danger zone

LIVING RESOURCE EXPLOITATION

-  Major fishing grounds (Shoreward of this line)
- F Fish haven
-  Kelp





NATURAL FORCES EXPLOITATION

- T Tidal power
-  Wind power harnessing

WATER CHARACTERISTIC RESOURCE EXTRACTION

- C Chemical extraction

EXTRACTION OF RESOURCES ON AND UNDER THE SEA BED

-  Oil rigs
-  Areas in which oil leasing has occurred
-  Areas under consideration for oil leasing
-  Potential areas for dredging of sand, gravel, and silt clay

WASTE DISPOSAL SYSTEM




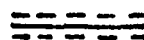
-  Chemical munitions/explosives dumping areas (disused)
-  Dump sites
-  Spoil area
- + Wrecks
- ▲ ■ Unexploded bombs, torpedoes, depth charges, and ordnance


FIGURE 4-2: LEGEND FOR "MAPPING" CURRENT SEA USES (Continued)


MEDIUM FOR TRANSPORTATION


 Traffic separation scheme

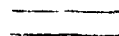
• Port

◦ Pilot area

 Precautionary area

 Bridge/tunnel


 Safety fareway

 Submarine transit lane


●— Pipeline

○— Sewer

SEA CITY DEVELOPMENT

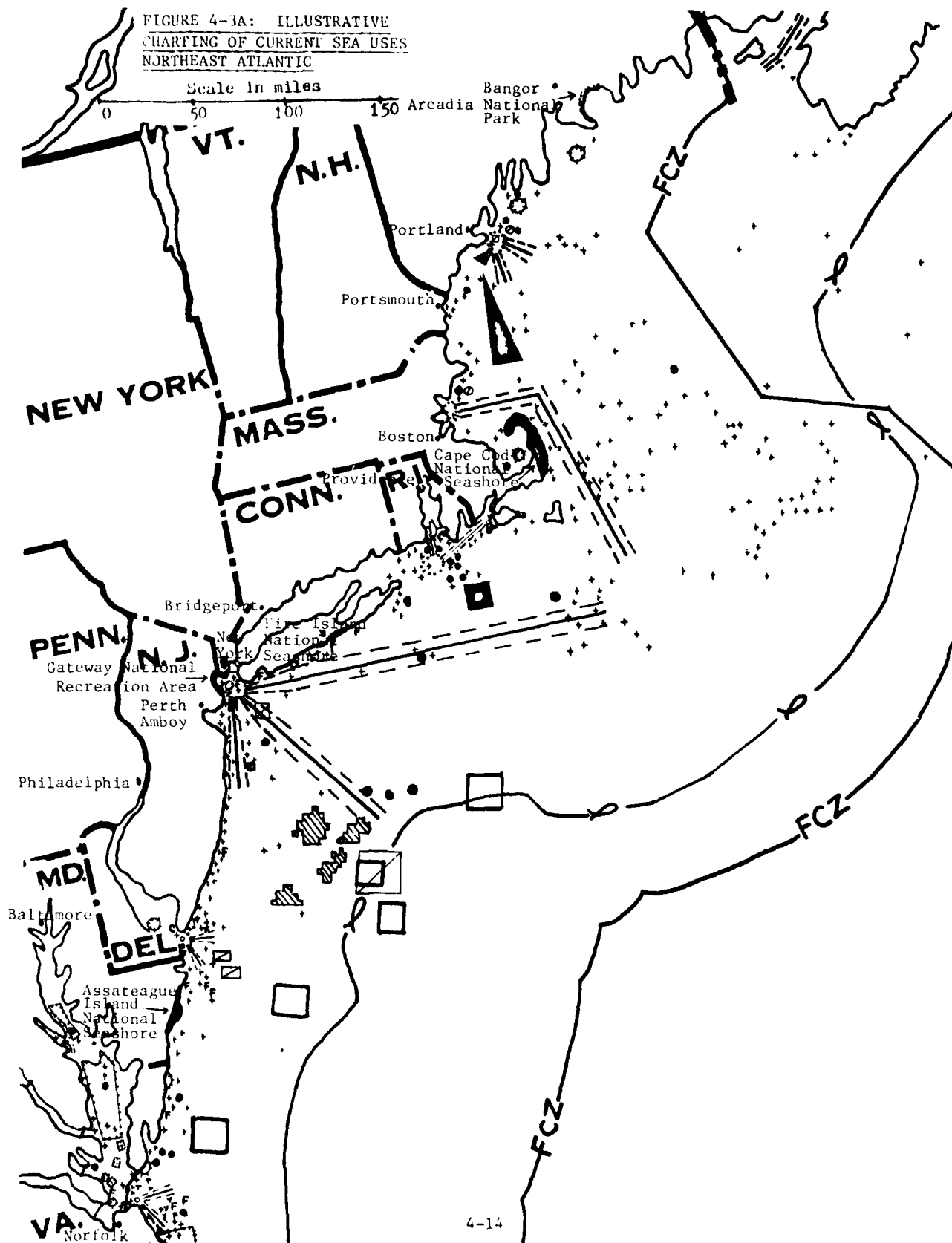
 At Marth's Vineyard (Massachusetts)

MEDIUM FOR RECREATION AND AESTHETIC ENJOYMENT

 Marine parks

Figures 4-3a and 4-3b illustrate how these current uses relate spatially within the Northeast Atlantic and Southern Pacific regions.

FIGURE 4-3A: ILLUSTRATIVE
CHARTING OF CURRENT SEA USES
NORTHEAST ATLANTIC



INVESTIGATION OF THE
SUBMERGED SEA UCCS - SOUTHERN PACIFIC

Scale in miles

0 50 100 150 200

FCZ

FCZ

FCZ

FCZ

MEX.

Point Reyes National Seashore

San Francisco

Channel Islands National Monument

Los Angeles

Long Beach

San Diego

The next step is to develop "overlays" which show the potential uses based upon the specific geographical/environmental features known and/or judged to exist within each region. Using the same legend as is shown in Figure 4-2 and an analysis of current knowledge about the geographic/environmental features of the Northeast Atlantic and Southern Pacific, Figures 4-4a and 4-4b show these potentials.

Note that these charts do not include all potential uses. They include only those which are related to unique geographic/environmental features of each region. Even some of these uses are also omitted for purposes of clarity. For example, other potential uses not charted are:

- Northern Atlantic

- Offshore nuclear power plants
- New or extended transportation lanes
- Single point moorings
- Ocean ranching or pen rearing of salmon (Northeastern U.S.)
- Pipelines (from oil fields to shore)
- Mining of coal off Massachusetts

- Southern Pacific

- Ocean thermal energy conversion off southern California
- Offshore windmills
- New or extended transportation lanes
- Dredging for sand, gravel, and shell
- Dredging for phosphorite off southern California
- Towing of icebergs from Antarctic
- Pipelines (from oil fields to shore)
- Marine sanctuaries

FIGURE 4-4A: ILLUSTRATIVE CHARTING
OF SELECTED POTENTIAL SEA-USES
NORTHEAST ATLANTIC

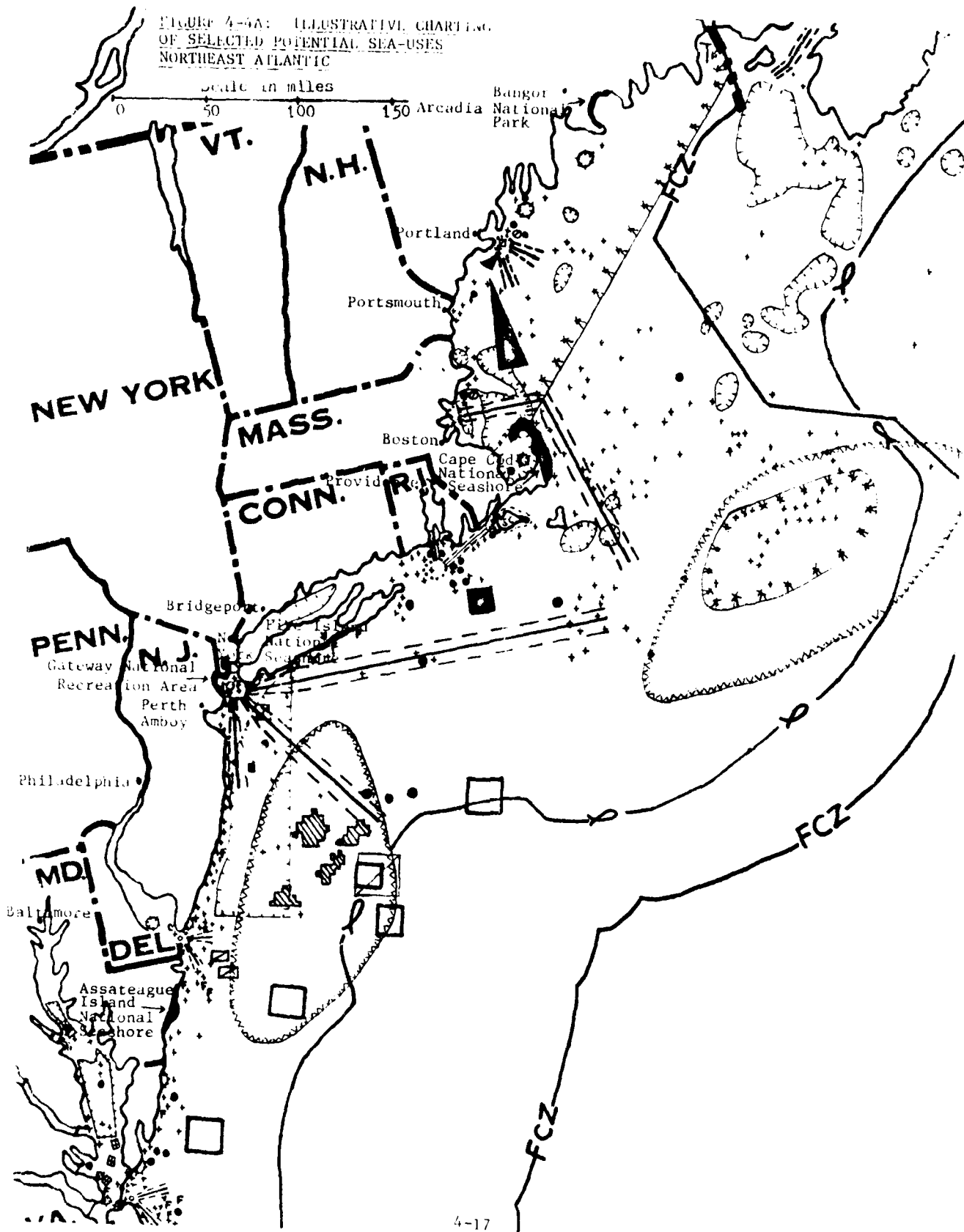
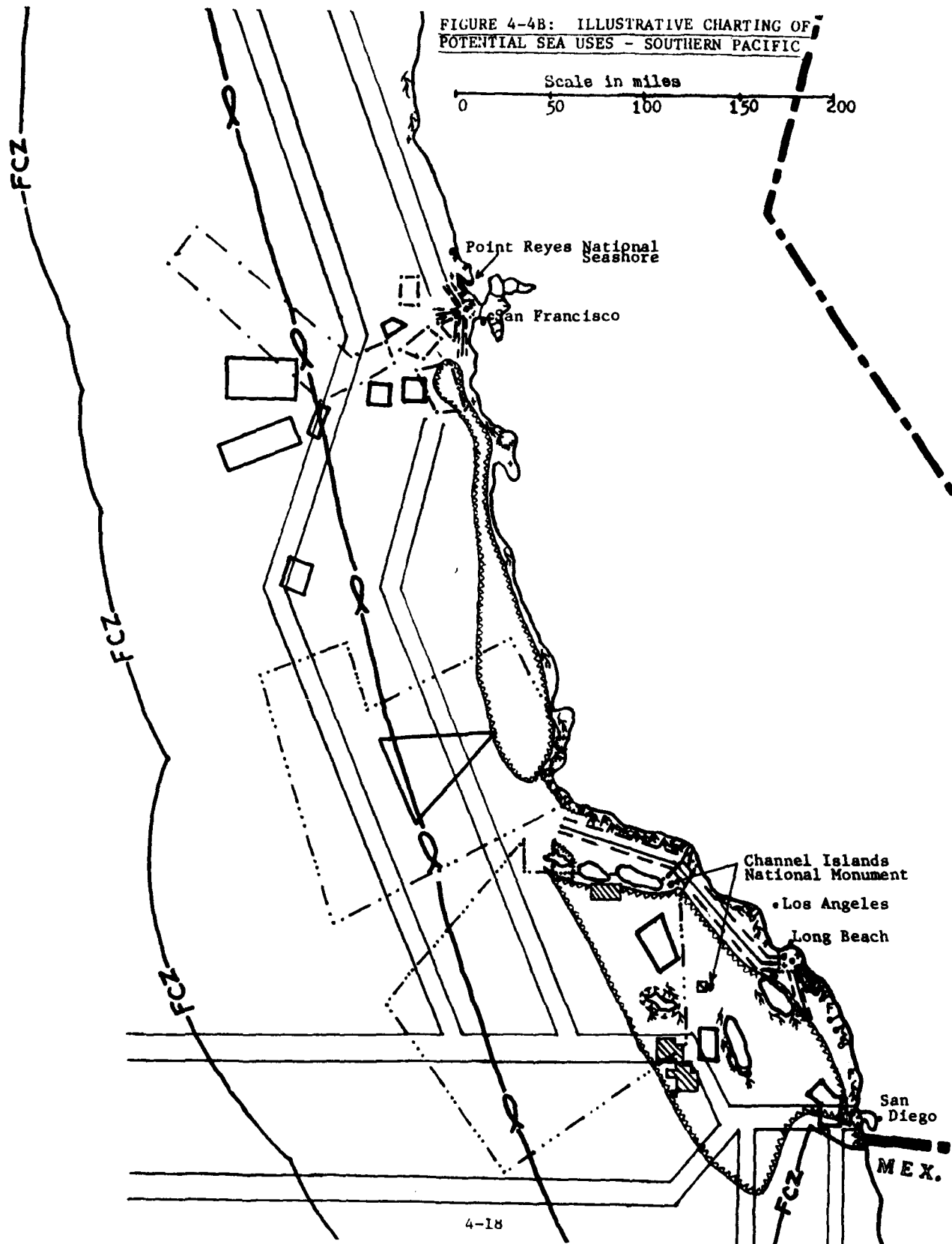


FIGURE 4-4B: ILLUSTRATIVE CHARTING OF
POTENTIAL SEA USES - SOUTHERN PACIFIC





The next task is assigning primary use allocations for each region. The site specific details required to make an accurate allocation for either of the illustrative regions are beyond the scope of this report. Accordingly, we employ for this step a hypothetical coastline/sea region.


The legend for the primary use was allocated in this hypothetical region as shown in Figure 4-5. Remember in viewing this illustration that a primary use allocation does not preclude other activities from occurring in the same area. Rather, the primary use allocation sets the basic standards by which other activities would be evaluated in terms of potential conflict.

FIGURE 4-5: LEGEND FOR ILLUSTRATIVE SEA USE PLAN OF A HYPOTHETICAL COASTAL LINE

MEDIUM FOR MILITARY ACTIVITIES

-  MILITARY NAVAL BASES
-  MILITARY OPERATIONS



LIVING RESOURCE EXPLOITATION

-  Foreign fishing
- * Aquaculture

NATURAL FORCES EXPLOITATION

-  Combined Marine current/
wind energy exploitation





EXTRACTION OF RESOURCES FROM SEABED

-  Petroleum products
-  Sand, gravel, and limestone




WASTE DISPOSAL SYSTEM

-  Dump grounds

MEDIUM FOR TRANSPORTATION

-  Ports
-  Traffic separation schemes
-  Petroleum pipelines
-  Wastes fallout pipelines



MEDIUM FOR TRANSPORTATION (continued)

-  Cables
-  Bridges
-  Tunnels

SPACE FOR LOCATION OF ACTIVITIES

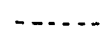
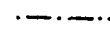
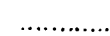
-  Offshore nuclear plant

MEDIUM FOR RECREATION AND AESTHETICS

-  Marinas
-  Marine parks

* * * *

BOUNDARIES

-  Contiguous Zone
-  200 mile limit
-  Continental shelf edge

APPROXIMATE SCALE: 1 1/2 inches = 150 miles

As an introductory note, the reader should be reminded that a primary use does not preclude other activities from occurring in the same area, but rather implies that other activities would have to meet certain requirements to avoid conflict with primary users.

We now proceed to make the primary use allocations as follows:

- Ports will have surrounding operational waters prioritized for port-related activities such as port entry, cargo transfer, ship repair, etc. Military installations in the coastal areas will be afforded priority for all military-related operations in such areas. Where military and port installations occur simultaneously, port activity will have priority in times of war or impending war. Traffic separation schemes will receive primary use status where they occur.
- Bridges and tunnels will be afforded priority.
- Only certain key systems of pipelines and cables that serve oil exploitation areas and dumping grounds, and that cross the ocean will have priority. This will be done to encourage uniform pipeline systems. Existing pipelines will not be necessarily required to dismantle or asked to interrupt flow, though they will have to meet certain operational requirements to avoid this.
- Certain areas have been designated for military primary use. These are for functions of training and practice. Military activities which involve other actual or potential primary use types of activities would require consultation on a case-by-case basis to establish priority. This would be the case only with military sea uses since they would not be covered directly by the marine affairs agency that is advocated in this report.
- Areas which offer petroleum or raw material resources beneath or on the seabed will be prioritized accordingly except where coastal installation areas and traffic separation schemes are present.
- Sites offering unique and geographically specific natural resource potential will have priority. One such site is designated for combining marine current energy extraction and wind energy conversion systems (shown as the channel between island and mainland on our "map"). Also, one site near each major urban area should be designated for offshore industrial operations (such as nuclear plants) with an appropriate avenue for resource movement. Such sites should be located sufficiently distant to vulnerable activities such as shipping.
- Marinas will be afforded primary use status, except where intersection with other major port installations (commercial or military) occurs. In such areas the marina itself would be considered a recreational primary use and surrounding waters would have to be prioritized according to the specific locations. In general, recreational boating on the water not immediately outside marina areas will not be considered a primary use.
- Areas that offer irreplaceable or vulnerable natural environments would receive priority as sanctuaries or marine parks. In our map, the park area received priority over the

traffic separation scheme, though this does not necessarily mean that vessels will be barred, but rather that the vessels must meet certain requirements to pass through (such as no bilging and no environmentally hazardous cargoes allowed).

- Dumping sites for chemicals will have precedence when they are far out enough and not in an area with cables (which would be a higher priority use than the dump site).
- Dredge spoil, industrial waste, and sewage sludge dump sites also will be categorized as primary use in areas in which they occur already, except where they occur in traffic separation schemes or port areas.
- Dumping would be a primary use, though in some areas there would be a limitation factor which would be determined by the degree to which the marine environment would be degraded.
- Industrial and municipal wastes entering the ocean areas would not be designated primary use status, except in specifically determined urban areas in which such wastes meet certain conditional requirements, i.e., treated wastes.
- Fishery areas in general will constitute primary use areas unless there are fixed marine activity systems, which could include transport lanes, pipelines, cable vessels, port areas, oil extraction areas, military bases, chemical dump sites, etc. Usually these common areas would have been designated for other activity primary use categorization. In the fishery grounds where species are endangered or depleted, there would be a prioritization favoring fishing as a primary use, particularly if such fish were commercially or environmentally important.
- In this map, specific areas are designated where foreign fishing is restricted. Any other area not assigned other primary use status is automatically prioritized for fishing.

Figure 4-6 summarizes these allocations in chart form.

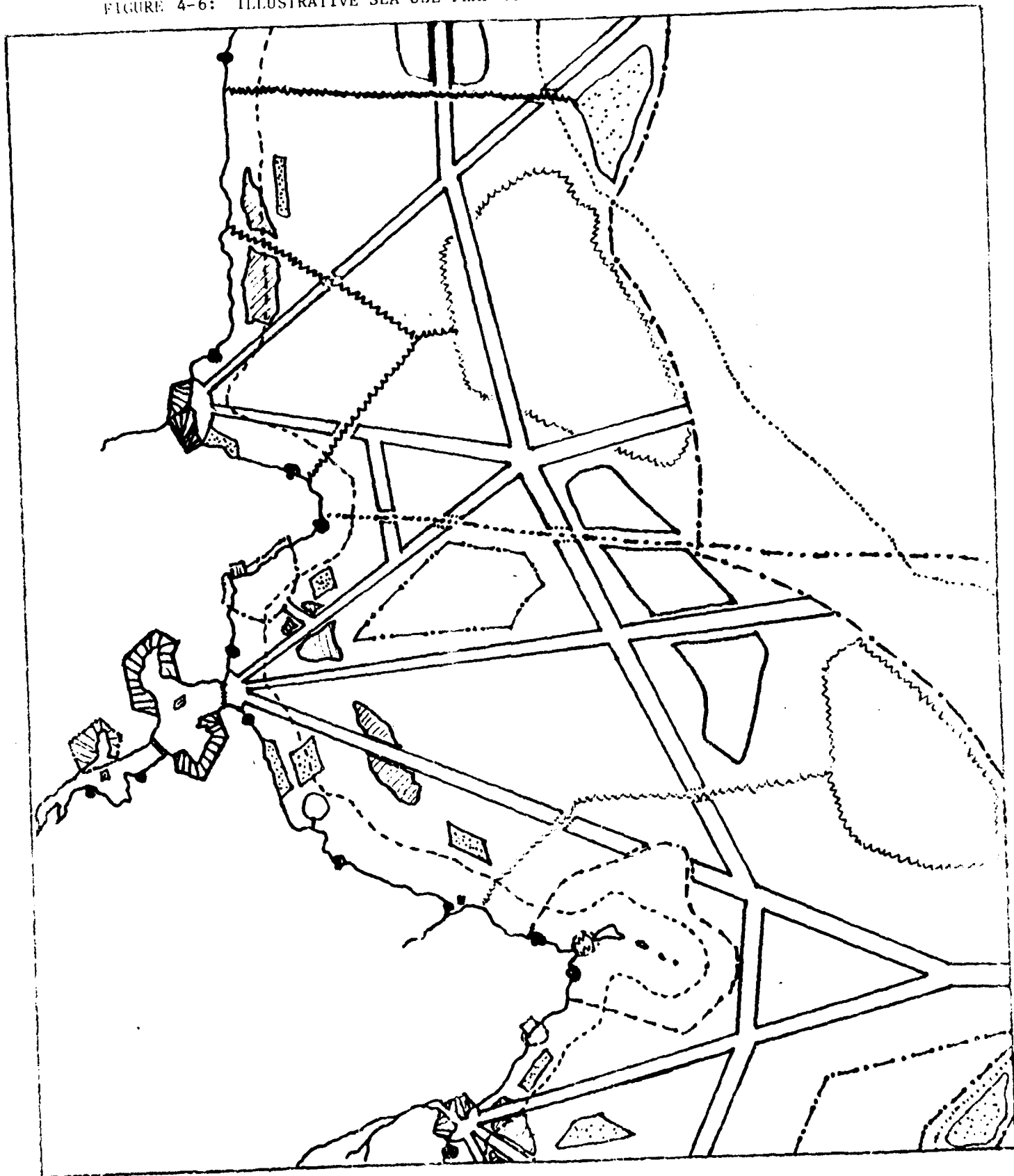
DEVELOPING AN ILLUSTRATIVE SEA ZONING PROCESS

As is clear from the above description, the sea use plan is a broad strategic policy planning document. A multiplicity of activities can be operating within various designated "control areas" so long as unacceptable conflicts do not arise.

The sea zoning authority will have operational capability, will be familiar in detail with the actual activities and their effects, and will control access to the various areas. The sea zoning authority is the final on-the-spot agency to determine that a given activity within a given area is permissible.

Steps involved in developing and maintaining a sea zoning process are as follows:

FIGURE 4-6: ILLUSTRATIVE SEA USE PLAN OF A HYPOTHETICAL COASTAL LINE



- 1) Determination of the use control zones
- 2) Development and implementation of regulations related to execution of the sea use plan which have not already been developed as a part of the various responsibilities assigned other functional agencies and/or resource managers
- 3) Publication of an integrated set of regulations related to activities within each respective region
- 4) Development and maintenance of appropriate use-control mechanisms such as licenses and/or permits and the needed systems for issuance and administration
- 5) Monitoring of the various activities to assure compliance with the intent of the sea use plan and with appropriate regulations and for various other appropriate purposes
- 6) Drafting of appropriate recommendations for refinements and/or changes to the sea use plan

Step 1: Determining the Appropriate Use Control Zones

It must be remembered constantly that the function of the sea zone control is not the same as land use zone control. The sea use plan lays out designated areas that are rather broad ranging and generalized, and which are related to the various strategic policies and natural features of the region.

The sea zone is an area designated as appropriate for access control and for monitoring of activities to assure that secondary activities are not unduly conflicting with either the primary uses or with other secondary activities.

In general, we would expect the sea zones to be specific areas marked by geographic boundaries such as quadrants or grids designated by latitude and longitude, with perhaps more detailed designations within the grids or overlaid upon them. Thus, the sea zoning map will be a map beginning with the areas as designated within the sea use plan and overlaying any additional details needed onto a grid structure which provides coordinates for easy identification and location. As a minimum, these zonal grids should be no greater than the standard longitudinal/latitudinal lines used for standardized marine maps.

Step 2: Development of Needed Implementing Regulations

The various sets of subsidiary policies and regulations needed to implement the sea use plan and legislative requirements may be viewed as of four types:

- 1) Those related to specialized resource management and which are issued by the respective resource managers
- 2) Those related to environmental quality standards which are issued by the designated agency for that purpose
- 3) Those related to public safety which are a result of interrelationships among the various uses and the specific local integrative networks of activities and natural features
- 4) Any other implementing regulations not covered by the above three categories.

Under our concept, category three and category four implementing regulations would be issued by the sea zoning authority who would be responsible for the sea zoning process, integrated assurance of public safety, law enforcement, and protection of property.

Step 3: Publication of an Integrated Set of Sea Activity Regulations

The complexity of the sea use management, planning, and zoning systems is inherently confusing. An integrated set of sea activity regulations is an important instrument in reducing confusion and assuring a more effective understanding of the system. Essentially, this is a document which acts as a single reference manual for purposes of any present or potential users/actors.

Step 4: Use Control Mechanisms

The function of the sea zoning authority is not so much to limit use as to control uses/activities to assure that they are not inconsistent with the plan or with regulatory requirements. This is more than a trivial distinction, and should remain as a constant policy standard. The basic presumption is that any potential actor will be permitted to engage in any lawful activity within the marine environment. They will be constrained from doing so only if the activity is inconsistent with or violates the policies set forth in the plan or in various other appropriate regulations published in the above integrated reference guide.

Some form of license or permit will be required for all activities except exempt activities under certain conditions. For example, an area designated for use as a recreational swimming beach may be open to all swimmers on a first-come-first-served basis, without need for acquisition of a permit to swim. Similar examples will apply to other types of activities.

However, all activities not specifically exempt will be conducted only after an appropriate license or permit has been acquired.

The basic criteria for granting a license or permit have already been outlined in earlier sections of this and the previous two chapters.

The key point is that an in-depth site-specific knowledge is required in order to render a qualified judgment as to the acceptability of the proposed use/activity. Once it is determined that the activity is consistent with the criteria and guidelines, access will be granted.

Step 5: Monitoring the Various Activities

In addition to procedures to determine and grant access, there is need for procedures to monitor activities continuously to assure that they are in compliance with the legal/regulatory requirements. Appropriate sanctions, up to and including revocation of access permits, will be needed to bring to bear upon offenders.

Step 6: Recommendations for Refinements to Plan/Regulations

Another function of the access control process is to determine the propriety of the sea use plan vis-a-vis the local conditions and situations. For example, new knowledge of sea resources or new localized developments might suggest the change of a primary use designation. Such indicated changes will be communicated to and recommended to those responsible for the sea use plan. Other needed refinements to laws and regulations will also be spotted by this on-site integrative monitor. Appropriate recommendations will be made to the appropriate functional agency.

The site-specific operational details needed to develop the specific regional sea zoning structure/system is beyond the scope of this effort. However, the above guidelines provide a structure within which the details can be completed.

SUMMARY

This chapter marks the completion of the first three of the six assigned tasks listed in the opening paragraph of Chapter 1. We now have the background for moving on to Chapters 5 and 6 which are to develop alternative national strategies for implementing the sea use plan/zoning concepts and for describing the possible Coast Guard roles involved in such implementation.

CHAPTER 5: ALTERNATIVE NATIONAL STRATEGIES FOR IMPLEMENTATION

This chapter outlines the alternative national strategies which could evolve in moving toward implementation of the sea use plan and sea zoning process outlined in the preceding chapter.

One cannot dismiss the potential that the nation may retreat from any further evolution toward an integrated sea use plan in favor of essentially a laissez faire system. As a result, the government would be involved only to the degree required for the national defense, for the regulation of commerce, and for the public safety. However, it seems clear that such a pattern is not probable. Trends are already well underway which suggest that the momentum is too great to be reversed. This is primarily due to the interrelationships between the activities and the "public ownership" of the seas which combine to make the need for some form of national sea management system a growing rather than a diminishing reality.

Therefore, in this chapter we begin with the forecast that the nation will continue to progress toward some form of a sea use management/planning/zoning system.

There are two patterns which could be developed:

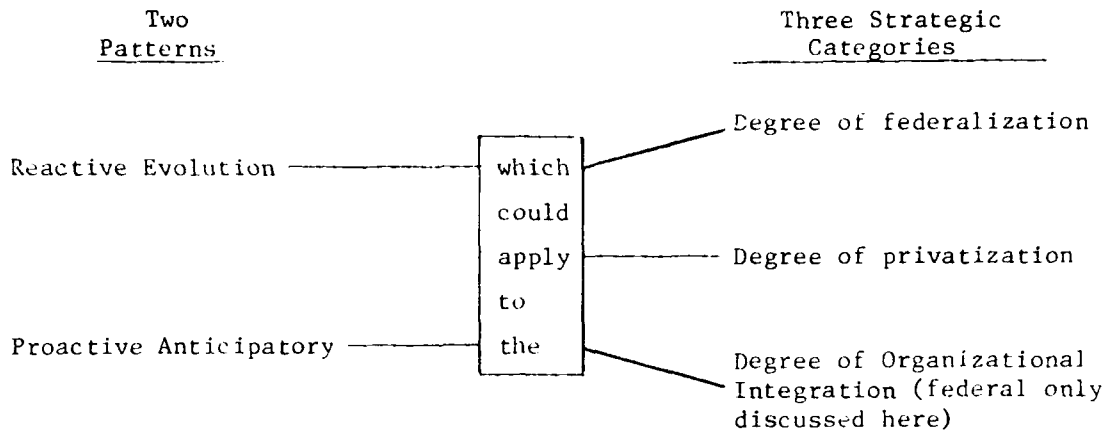
- 1) A reactive evolutionary pattern in which national policies and actions result from crises or significant problems "after the fact."
- 2) A proactive anticipatory pattern in which movement toward appropriate national policies and mechanisms are initiated before any more significant problems or crises emerge.

Within each of these two patterns, there are several alternative strategies which can be classified into three categories:

- 1) The degree of "Federalization"
- 2) The degree of privatization
- 3) The degree of organizational integration (discussion herein is limited to that of the federal government, since it is that which will determine the roles of the Coast Guard--the objectives of this study).

The above reasoning can be summarized in the diagram of basic strategic relationships shown in Figure 5-1.

FIGURE 5-1: BASIC STRATEGIC RELATIONSHIPS



Since the three strategic categories are equally related to either the reactive or proactive patterns, we shall discuss first the two patterns and then the three alternative strategic categories.

A REACTIVE EVOLUTIONARY STRATEGY

The basic features of this strategy are characterized by the phrase: "continuation of current policy." This essentially suggests that the nation will not move to the formulation of integrative sea use zoning, planning or management except when an unavoidable, clear imperative arises for such a development.

Actually, this pattern would be much more consistent with historic precedent than the anticipatory pattern. Despite the fact that current dialogue is building for some form of integrative national sea planning, zoning and management system, it is highly likely that events will overtake the normal lag from concept to action.

This pattern will be one in which a variety of departments and agencies, independent of one another, will continue to develop their segmented specialized policies, programs and regulations. These policies and programs will become the basis for a variety of private initiatives which may fall outside the contemporary coverage of specialized agency responsibilities and activities.

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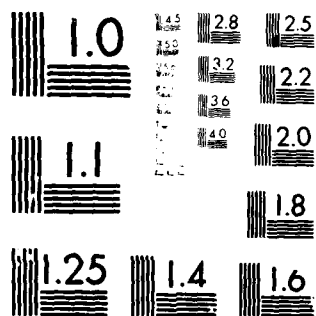
WILLIAMS (CHARLES W) INC ALEXANDRIA VA F/G 5/4
SEA USE PLANNING AND ZONING MANAGEMENT: AN EMERGING NATIONAL NE--ETC(U)
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MICROCOPY RESOLUTION TEST CHART
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A PROACTIVE ANTICIPATORY STRATEGY

This strategy would represent a fundamental departure from current policies. It would be characterized by the designation of formal national objectives aimed at establishing an appropriate national sea management system, sea use plan, and zoning process. Specific role assignments would be made, and appropriate guidelines developed. Such an initiative could originate in either the Executive or the Legislative Departments of the federal government. It could be stimulated by either the leaders within the federal government, demands by state governments or demands by various constituencies and private interests.

Current discussions of the need for a reorganization and an updating of governmental roles and responsibilities vis-a-vis the seas is the first step in the evolution of decisions to stimulate this pattern.

Even though such a pattern would be inconsistent with most of our national history, we think the need is becoming focused clearly enough to make this a reasonable probability by the mid 1980's. It could occur well before that time, but if it does not, the needs will be approaching the point where even the reactive pattern will be taking effect.

Within this concept, there are but another scant three or four years in which the anticipatory pattern can be instigated. Subsequent to that, events will have moved to such a point as to make the patterns essentially reactive in nature.

DEFINING THE STRATEGIC CATEGORIES

Strategies Related to the Degree of Federalization

There are several strategies available:

- 1) A reversal of the current coastal water concepts and the establishment of a fully integrated federal ownership and jurisdictional control.
- 2) A continuation of the current system with state "ownership"/controls being applicable to the coastal waters and to any activities outside those waters which affect activities within such waters.
- 3) A restriction of the state's authority to the coastal waters, leaving the federal government the sole arbiter and actor capable of establishing sea use plans and related implementing mechanisms.

- 4) An extension of the current states' scope of rights in coastal waters by increasing the range of state ownership beyond the three-mile limit marking the coastal water.

Strategies Related to the Degree of Privatization

Private activities within the seas result from a variety of motivations:

- Individual desires for recreation/pleasure or other leisure pursuits
- Individual desires for economic pursuits
- Organizational desires for economic pursuits in some form related to taking resources from the sea to the land, or using the sea itself as a resource
- Organizational desires for economic pursuits related to providing services to others who are operating within the oceans, i.e., the marine service industry

Governmental activities within the seas may extend into a variety of roles and levels of activity:

- Limits to those activities essential to military, law enforcement, and public safety
- Extension to those activities related to the development of sea resources
- Extension to those activities related to operation of the sea economy as federal corporate activities

The number series begun in the preceding section is continued for simplicity of identification. In general, the basic alternative patterns which could evolve are as follows.

- 5) Maximum governmental operations as the operational developer and financier of the seas. In this case, the role is that of owner/operator to a maximum degree.
- 6) Governmental policy and other resource development incentives and management with maximum private operational development and continuation but in a direct performance contractual relationship to government. In this instance government "hires" private organizations to develop and operate the marine economy.
- 7) Governmental policy management which provides guidelines and some incentives for private development and operation of the marine economy as a private enterprise activity rather than as a contract performer for government.

- 8) Governmental policy to have governmental personnel and equipment perform operational roles associated with government services.
- 9) Governmental policy to have contractor personnel and equipment perform operational roles associated with government services.

Strategies Related to the Degree of Federal Organizational Integration

- 10) Integration of all marine affairs (policies and operations) into a cabinet level department or its equivalent (excluding the operations of the Department of Defense).
- 11) A split version of such a nondefense marine affairs department into policy and operational department and a regulatory department.
- 12) A continuation of the current mixed system in which various functional responsibilities are shared by various agencies and departments as adjuncts to their land-based functions.

DISCUSSION OF THE PROBABILITIES

The above twelve strategies which occur in either the reactive or the anticipatory framework provide a potential for twenty-four strategic patterns which could evolve. These twenty-four patterns are not mutually exclusive, and, in fact, the future will most likely include some elements of each. However, there are some dominant themes which will probably occur and others which will occur. This section outlines our tailored forecast on these extremes, and then summarizes the above structure into a matrix providing our probability estimates.

Degree of Federalization

State "ownership" of coastal waters which are defined as those reaching three miles from shore, appears to be an established right. However, it will be a contested issue. As the marine economy develops and economic stakes grow the coastal states will seek to push their rights of control further from shore. At the same time, inland states will be seeking to gain access to the economic value flowing from coastal waters. In still other instances, these inland states will likely seek through the courts, access to offshore resources. For example, if a rich natural gas field exists and a coastal state has not permitted those resources to be tapped, inland states whose economy and living conditions are severely

affected by natural gas shortages may well sue for developmental rights to the gas. This is not unlike recent issues involving the requirement for states producing natural gas to export gas to other states under court orders to do so.

In addition , private enterprise operating economically in national waters are not likely to welcome contending with individual state laws and regulations. Since most of these organizations will be national types of corporations, or at least companies operating in more than one potential state jurisdiction, heavy resistance to extension of state ownership can be expected to grow in direct proportion to the level of economic development and activity within the national waters.

Finally, federal government resource managers will also be unlikely to welcome the extension of state's ownership over the resources for which they have national developmental, conservational, and managerial responsibility. This will be primarily based upon the arguments that various state laws and regulations will be much more complicated to deal with, potentially retarding development and producing less desirable management systems.

Given these factors, our expectations would be as follows:

- It is highly probable that state control of coastal waters will remain a reality, but this will probably be constrained to the currently defined three-mile limit.
- The degree to which coastal states can have significant control over activities in national waters outside the coastal zone will be operationally eroded to such a degree as to be relatively insignificant.

Degree of "Privatization"

Despite the growth of the scope and level of governmental operations, the U.S. remains today committed to the concept of an economy dominated by private enterprise than by governmental enterprise.

There are, however, a number of areas in which governmental policies and incentives for innovational developments are viewed as the only means whereby such innovations can be spawned. This "mixed economy" situation is likely to hold true for the marine environment.

In general, we would expect that the government may act as the operational developer and financier of some major marine developmental activities which

have a direct and important relationship to national goals. One possible example is the development of sea mining for critical materials. For these limited areas the government will probably act in a variety of ways:

- As operational developer through public corporations
- As a policy incentive to stimulate private investment
- As a contract purchaser of development operations with private firms performing the actual operational execution

However, in general we would expect that the governmental role at the federal level will be one in which maximum utilization is made of private enterprise insofar as the development and operation of the marine economic activities are concerned.

There will be significant federal and state governmental operations in such areas as sea parks and maintenance of conservation areas, similar to the operations found on land facilities.

In addition, the federal government will likely remain the major operational agent involved with actual enforcement of laws and guardianship of the public safety.

The governments of coastal states are more likely than the federal government to take developmental/ownership initiatives. This is because their state economies would benefit more than the federal government. These will raise some significant issues with respect to the inland states, and with respect to the rights of private enterprise. For example, an inland state which does not have deposits of crude oil and which has a major shortage might incorporate a state corporation to develop an offshore oil field with a pipeline running into the state. Such a state would sue the coastal states involved if necessary for the right of access for the pipeline.

In summary, our expectation would be for an increasing degree of mixed marine economy in the sense that virtually all forms of the privatization/governmentalization spectrum will be in operation in one activity or another. However, the operational activities within the marine environment as a whole will be more private than public in nature.

Degree of Federal Organizational Integration

The current mixed system of multiple agencies involved with several aspects of the marine environment is deeply entrenched within the federal bureaucracy.

It will not be an easy structure to alter. The complexities associated with such attempts are profound in technical, political and economic terms. Accordingly, we would expect several more years to pass before any significant degree of federal integration of all activities into a marine affairs department or its equivalent can emerge.

At the same time, we have forecasted, here and elsewhere, that the growing array of activities and importance of the marine environment as an economy will tend to intensify the debate for a department integrating all marine affairs. By the mid to late 1980's we would expect that such a department will be established, and that the bulk of marine affairs will be transferred into it. There is a strong chance that the developmental and the regulatory functions will be separated organizationally, as is the case in a number of major areas now.

Until this integration takes place, the most powerful integrating force within the emerging sea use structure will be either the sea use plan or the agency charged with the ultimate decisions about how activities will affect the public safety and the operational ability to enforce laws and protect property. At the present time the Coast Guard is the prime candidate for the latter role.

Summary

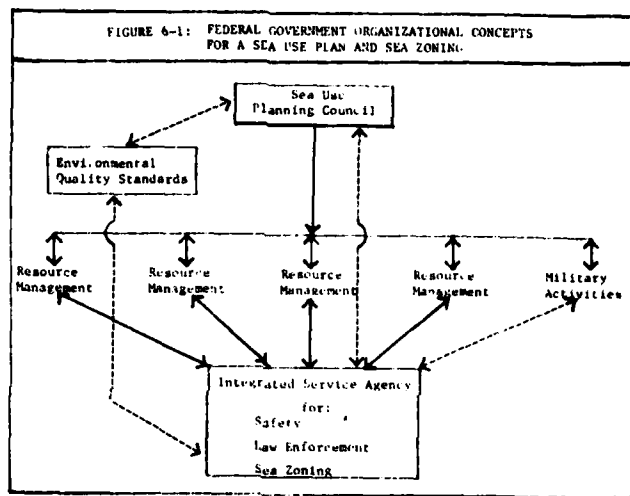
Figure 5-2 summarizes the above alternative patterns whereby the nation can move toward the sea use plan and sea zoning process, together with our probability assessment with respect to each.

FIGURE 5-2: SUMMARY ALTERNATIVE NATIONAL PATTERNS
FOR MOVING TOWARD SEA USE PLANNING

Basic Pattern	Probability
1) Reverse states' control over coastal waters	Very unlikely
2) Continued expansion of state control of activities outside coastal water which affect activities within coastal waters	Very unlikely
3) Restrict states' control to coastal water with federal control beyond	Very likely
4) Increasing 3 mile coastal waters limit	Very unlikely
5) Maximum governmental owner/operator	Likely in selected activities
6) Government owner/operator through contract operations	Likely in selected activities
7) Government policy incentives for private development	Very likely in selected areas
8) Government personnel perform governmental service roles	Very likely to be the general policy
9) Contractor service personnel	Likely in limited areas
10) Integrated cabinet level department	Likely after mid 1980s
11) Integrated operation with separate regulatory agency	Very likely around 1985-87
12) Continue current mixed system diffused responsibility	Likely until mid 1980s

CHAPTER 6: POSSIBLE COAST GUARD ROLES IN IMPLEMENTING THE SEA USE PLANNING AND SEA ZONING PROCESS

This chapter summarizes the preceding analysis in the context of possible Coast Guard roles in the sea use planning and sea zoning process. By way of introduction, we review the basic concept of federal government organization developed in Chapter 3. Figure 6-1 shows that concept.



Remember that the criteria for the integrated service agency included an on-site operational capability. In our view, the Coast Guard's capability and current role within the federal structure make it the most logical agency to fulfill this integrated position. This holds true under any of the potential patterns outlined in Chapter 5. Thus, it is our view that the Coast Guard is well suited for the role of sea zoning authority, which is an important component of an integrated service function.

The preceding chapters describe the integrated service function as encompassing law enforcement, public safety, and the management of a sea zoning process.

This role will not fall automatically on the Coast Guard. There will be considerable debate about whether to have an integrated support agency even for public safety and law enforcement. There will also be debates about the need to form several independent agencies having operational capabilities in many Coast Guard functional areas. There will be efforts to place the responsibilities for sea zoning and sea use planning under a single agency, with it being given the authority to develop whatever operational capabilities are needed. Should these arguments prevail, then a rather extensive and costly redundancy of operational marine capacity will evolve within the overall federal structure. A logical outcome to such a pattern would be a major reorientation of the Coast Guard's current roles, probably reducing significantly its responsibility and scope of actions.

For the purposes of this report, we are assuming that the Coast Guard will be designated as the integrated support agency, since that appears to be the most effective and efficient evolution to follow. Should this prove to be ultimately incorrect, work done during the intervening years where the Coast Guard remains intact will still prove to be invaluable to the national interest.

THE POSSIBLE COAST GUARD ROLES

From the above reasoning, we therefore view the possible Coast Guard role within the context of this report as the integrative service agency and as the Sea Zoning Authority. It would act as an important advisor for resource managers, the sea use planning council and the agency (or agencies) responsible for environmental quality standards.

A critical part of the integrated services role will be the responsibility for developing and monitoring regulations which deal, insofar as geographic location and proximity of activities are concerned, with the public safety and the protection of property and life: i.e. those regulatory standards which will determine what multiple activities can occur. Some of these responsibilities are already a part of the Coast Guard's mission, and we believe that they will grow substantially.

Since coastal waters will be the most crowded, the Coast Guard will need to work closely with the impacted states in establishing national standards for interactivity safety regulations. It seems probable that the states might

be subsidized to monitor compliance within coastal waters, thus freeing the Coast Guard's main operational capability for those activities outside of them. However, in view of the nature of the marine environment, we believe that the Coast Guard will need to retain some form of clear jurisdiction so that it can operate in conjunction with state agencies wherever circumstances warrant. Also, under certain conditions, the Coast Guard will need to enforce laws and regulations in coastal waters, even without the state agencies involved.

In this domain, a carefully structured network of interacting agencies will be needed. It seems that marine law enforcement activities are not as clearly delineated as land-based ones.

These roles imply that there will be a need to understand much more about how to set safety standards governing the multiple activities which can occur in a geographic relationship. They will ultimately determine what kinds of secondary activities can occur, and in certain zones, the conditions required even to conduct primary activities. This is a logical extension of current responsibilities related to traffic control and navigational systems.

There will, however, be a significant difference in the Coast Guard roles and responsibilities between the reactive and the anticipatory modes or patterns of national movement toward sea use planning and zoning processes.

As was discussed in Chapter 5, we estimate that the reactive mode of development is the most likely to occur at least between now and the middle to late 1980s. It is within this operational environment that Coast Guard roles and responsibilities will most probably be forged.

However, it is not beyond conception that a more immediate series of anticipatory national policies might emerge which would begin to assign responsibilities for sea use planning. Once such a responsibility is explicitly assigned, the operational effect will be the same as if the policy were to be formulated as both a sea use plan and sea zoning process. Anything evolving in this direction will have the basic operational effect of developing patterns somewhat consistent with the principles and concepts developed within the earlier chapters of this report.

Thus, it is possible that the Coast Guard will be "pushed" more rapidly under some form of modified anticipatory policy pattern which, though it is not

a comprehensive and integrated movement toward overall sea management, still establishes an earlier concept of sea use planning.

It would be our view that the Coast Guard will not be a very likely candidate for the assignment of the sea use planning responsibility. However, we would expect that planning entity--whomever it might be--to rely upon the Coast Guard heavily for advice and probably to request operational support in its monitoring the actual implementation of the plan. This estimate results from the combined facts that the Coast Guard is the most operationally competent agency to perform the task and that overall Coast Guard roles and missions make it the most likely and reasonable agency to perform the function in the most efficient and cost-effective manner.

Finally, we should note that it would be possible for the Coast Guard to move in an anticipatory manner even though explicit policies establishing a sea use plan may not be issued. For example, the Coast Guard could begin developing public safety standards and applying them as part of its present responsibilities. Unless an integrated marine affairs department is established, the Coast Guard will evolve as the key integrating agency whose advice will be needed relative to developmental programs being planned and undertaken by the respective functional agencies. It is the Coast Guard who presently sees the integrated picture from an operational standpoint. No other agency has this total responsibility which is inherent to the concepts of public safety and protection of life and property.

To summarize, then, there are four basic scenarios which appear appropriate for Coast Guard planning and management:

- 1) The overall national government, including the Coast Guard, continues to evolve toward the sea use planning and zoning processes in a reactive, evolutionary pattern--a continuation of the current trends.
- 2) The Coast Guard takes an anticipatory mode within the above scenario and begins to formulate knowledge and understanding needed to effectively fulfill its role as it will likely emerge under this pattern.
- 3) The national government will make an early policy calling for a sea use planning process and designate a specific agency to be responsible for such a plan--but probably not the Coast Guard.

- 4) The national government could move immediately and rapidly, within the next year, to an integrated department of marine affairs and an overall comprehensive sea use management, planning and zoning system.

We shall now discuss the specific subscenarios or vignettes for the Coast Guard under each of the preceding basic scenarios. The scenarios are not discussed in the same order presented above to facilitate the flow of ideas and enhance communication.

A COAST GUARD VIGNETTE UNDER SCENARIO NUMBER 4:
RAPID NATIONAL ANTICIPATORY MODE/PATTERN

In this situation the Coast Guard would retain as a core of its operational roles and missions the following basic responsibilities:

- The lead agency for public safety and for the protection of life and property in the seas
- The lead agency with operational responsibility for regulatory and law enforcement in the seas
- The agency designated as the sea zoning authority
- A continuation of its military/defense roles and responsibilities

This Coast Guard vignette would then unfold essentially as we have discussed in Chapters Three and Four.

A COAST GUARD VIGNETTE UNDER SCENARIO NUMBER 3:
NATIONAL POLICY FOR A SEA USE PLAN AND DESIGNATION
OF A RESPONSIBLE AGENCY FOR SUCH A PLAN

It would be our estimate that such an agency will not be the Coast Guard. It would be either an adjunct to current agencies (possibly NOAA)--although we believe that would be a mistake--or it could be accompanied by establishment of a special marine planning council or office within the Executive Offices of the President or elsewhere. In any event, the legislation will most likely designate the Coast Guard as being responsible for advise and assistance to the planning agency as appropriate. Even if the legislation does not take such a direction, the planning agency will need to turn to the Coast Guard for its advice and assistance. The Coast Guard's advice would be on public safety and law enforcement. Yet they will not be the only agency stipulating where or what kinds of activities are allowed to take place. Developmental resource managers and other specialized agencies would be doing likewise in their areas of responsibility.

The Coast Guard would also be asked to support the sea use planning entity by monitoring the degree to which the plan is receiving compliance. This would naturally accrue from the operational capability of the Coast Guard and the fact that the Coast Guard maintains surveillance of marine activities in pursuit of its other missions and responsibilities.

Although it would have no formal legal status in legislation as such, the operational effect of this development would be nearly identical to a specific assignment of the sea zoning process to the Coast Guard, making it the sea zoning authority.

A COAST GUARD VIGNETTE UNDER SCENARIO NUMBER 1:
COMPLETE REACTIVE MODE INCLUDING COAST GUARD

We will now begin from the other end of the scenario spectrum by outlining what would happen if the Coast Guard and other federal agencies continue to act in a slower evolutionary and reactive pattern.

Already important elements of a sea use planning and zoning process are in place. However, the integrating focus of what activities can be conducted in relation to what other activities is still relatively new. Establishment of ocean transportation lanes has in effect been a primary use designation of certain sea space, as is also the case with various other exclusive or restricted area designations.

Recently, the environmental impact of oil well development on shellfish and upon recreational uses in coastal waters has been raised as an illustration of a "crowded condition" problem. However, in general, there have not been enough multiple and conflicting activities to require an integrating focus on what is permitted to occur within the same sea space.

These types of conflict will increase rapidly over the next two decades. While the intensity will be greatest in the coastal waters, it will also be felt significantly in major water areas beyond the three-mile zone.

Accordingly, the Coast Guard will be increasingly pushed into the role of a focal agency whose mission requires that it consider how public safety, protection of life and property, and law enforcement come together.

The Coast Guard will begin to realize that the lack of integrative activity, safety, and operational standards is creating not only severe public safety

hazards but is also imposing operational responsibilities which it is not equipped to handle. The load of emergency responses and crisis management will increase to a point where the economic costs of not having an ordered and appropriately integrated standard is no longer bearable. These costs will be a combination of the expenditures required for the Coast Guard (and other agencies) as well as the costs to the public of major accidents associated with conflicting marine activities.

As the patterns become more clear, the Coast Guard will be increasingly looked to as the agency whose expertise and responsibilities give it the ability to advise individual federal and state agencies upon their developmental plans. Private organizations will also begin to ask for assurance that their permits and licenses (now issued by both functional agencies and by the Coast Guard) will guarantee continuity of their activities.

Thus, the Coast Guard will be slowly pushed toward the requirement to evolve for its own purposes, a type of informal public safety integrated activity standard. Although it will have no formal recognition as such, this process will result in the emergence of something closely resembling sea zoning.

The impetus to formalize it will most likely be the consequence of a major disaster or series of disasters, and the resulting public outcry.

A COAST GUARD VIGNETTE UNDER SCENARIO NUMBER 2:
COAST GUARD ANTICIPATORY MODE WITHIN OVERALL REACTIVE MODE

It is possible for the Coast Guard to visualize the evolutionary pattern discussed in the previous section and to begin an anticipatory management approach now. This would, in our judgment, be by far the best approach for the Coast Guard to take.

In this context, the Coast Guard would begin to prepare for its already emerging role as advisor to a variety of agencies on the implications of their activities and programs for public safety, and upon the various considerations which are needed to be taken into account with respect to navigational and safety aids, traffic control systems, regulatory monitorship and inspection and law enforcement of various other types.

The Coast Guard would begin to develop integrated activity standards which would define conditions under which various activities are in conflict with one

another. Alternative operational budgets for protection of life and property and for public safety would be developed under varying assumptions about the density and intensity of various activities in the marine environment.

Specialized transportation channels for hazardous materials and all commercial traffic would be evaluated in order to determine the relative cost and effectiveness of law enforcement and safety.

COAST GUARD IMPLICATIONS

The implications to the Coast Guard of sea management, sea use planning, and sea zoning processes are significant. Under almost any of the patterns discussed, the Coast Guard and the federal government will have moved into the system with which to open the next century by the early 1990s. Thus, very real planning issues exist right now. A few illustrations will make the point:

- As the diversity, density and intensity of sea activities increase, the problems of public safety and law enforcement will increase even more steeply--perhaps exponentially. The ways in which interactive standards are set--or not set--will have major impacts upon the level of operational capability the Coast Guard will be required to have in the conduct of its traditional missions.
- The degree to which private investments in sea activities are secure can be vitally affected by the degree to which the investing companies have a sense of understanding of the continuity principle. If there are risks of losing their operational rights due to infringement of other activities, or if they must increase investments substantially in order to remain active, the dampening effects upon sea development can be substantial. This development will impact upon the federal government to take an even greater role as either financial guarantor or as operational developer. Either will have significant public budgetary implications, although they would not fall directly upon the Coast Guard.
- At least several otherwise preventable disastrous accidents will occur because anticipatory standards were not developed and operationalized. The Coast Guard will not escape unscathed from the public outcries which will follow such events.

Due to its traditional and present roles and missions, the Coast Guard is not without responsibility to begin preparation for its role in the emerging sea management, planning and zoning processes/systems. The types of actions which appear most productive are outlined below:

- Begin the background research necessary to develop interactivity protective standards oriented to property and safety.
- Begin the analyses which will provide an effective foundation upon which to evaluate the trade-offs between various degrees in interactivity standards and in the related operational missions associated with protection and regulatory/law enforcement.
- Begin to design Coast Guard equipment and organizational structures to blend into this emerging mission expansion. Equipment designs should be on hand ready for the procurement cycle even now if they are to be in the operational inventory by the mid 1980s.
- Begin to articulate its roles and responsibilities in such a manner as to receive the formal recognition and hence the full coordinative position in policies made by other agencies which have a direct and important impact on public safety, interactivity conflicts and upon the support missions and operational requirements of the Coast Guard.
- Parallel with the above steps, make a more positive movement in fulfilling its integrating role of advisor to the various public and private agencies. This in turn will require development of an organizational and manpower capability to perform such a role.
- Begin to build these concepts into high-level management, manpower development, and training programs, thus enhancing the flexibility and capacity of the Coast Guard personnel to absorb these roles and responsibilities and perform them with traditional Coast Guard effectiveness.

All of these actions would be appropriate in the near term under any of the patterns which have been discussed. In this sense, they appear to be quite sound and solid bases upon which to begin effective planning and research activities.

APPENDIX: TAILORED MACRO/MARINE ENVIRONMENTAL FORECASTS
RELATED TO SEA USE PLANNING AND SEA ZONING PROCESSES

This appendix outlines in more detail our tailored forecasts of those future developments in the macro and marine environments which will most significantly affect sea uses and activities as they relate to sea use planning and zoning. The following discussion is itself a summary of much more detailed sets of forecasts developed in other recent reports done by our firm, referenced on page 2-2 of the main body of the report.

The appendix is presented under a series of discrete headings:

- Political/Military
- Antisocial Technology/Activities
- Economics
- Physical Resources (General Forecasts)
- Ocean Minerals/Mining
- Desalination
- Living Resources
- Transportation
- Pollution/Waste Management
- Climate and Natural Forces/Disasters
- Offshore Location of Processing Plants and Habitats
- Recreation
- Research and Development

Although these captions are treated as units, they are inextricably intertwined. All forecasts are interrelated with all other forecasts. Thus, these future developments should be read as a pattern outlining a general profile which we believe will evolve by the turn of the century.

POLITICAL/MILITARY

The concept of national sovereignty will remain as a dominant feature of international relations. It will be relinquished only when it serves a nation's best interest.

World power will diverge from a bipolar world, largely organized under the USSR communist bloc and the U.S. free-world bloc, to a multipolar network of nations and blocs. It will be increasingly difficult to negotiate or to impose world order. While a direct nuclear exchange between the USSR and the U.S. cannot be ruled out, we forecast its probability to be so low that is not included with this set of forecasts.

As the multipolar world emerges, there will be a general proliferation of world military power. The "nuclear monopoly" will be eroded in two senses, by the proliferation of nuclear power itself, and by the emergence of antisocial technology which could give many nations the equivalent destructive effectiveness of nuclear power. This latter situation might be termed the emergence of non-nuclear strategic parity.

The techniques for calculating parity will be expanded to incorporate not just nuclear but overall military parity. The number of nations with overall military parity will increase. U.S. policy will strive to remain effective against any potential enemies who may emerge from such an increase.

There will be accelerated efforts to effect world disarmament. These efforts will achieve limited success by imposing complex monitoring systems on specific types of arms. There will not be a successful achievement of overall arms limitation, and complete disarmament is not even a possibility. Rather, the range of potential weaponry and military capability will increase. The arms race will enter into its next plateau, and the overall military capability of the world in general, and the U.S., in particular, will continue to build with some significant changes.

The U.S. will continue as a leading world power, retaining effective military capability.

The basic role and nature of marine military activities will change greatly. The marine environment, itself, will become a source of conflict, since its role as a moat and protective barrier is radically changing to a protective cover for strategic nuclear attack, and its role as a boundary which contains encounters between at-sea adversaries is giving way to encounters of force between weapons systems within the marine environment and targets outside it, or vice versa.

Naval strategy and tactics will shift toward more extensive development of underwater military capabilities. Military defense will have to be increasingly attuned to include significant offshore industrial activities. The more traditional role of the marine environment as a means of massive logistic support is becoming more tenuous. Additional reassessment of the marine environment as a transportation medium is required (vis-a-vis a nation's capacity to control the transportation of vital raw materials).

These issues will, as resource dependency increases, become more complex. The U.S./USSR naval race will take into account these realities and will be adjusted accordingly. Eventually, the third world will use nuclear weapons at sea. There is a chance that such extensive nuclear activity could lead to radioactive pollution. The impact of such an occurrence on the world will be dependent on the parties involved, their relationship to the "great powers," geography, and the intensity of combat.

ANTISOCIAL TECHNOLOGY/ACTIVITIES

Advances in antisocial technologies will continue, increasing the potential of nonnuclear strategic parity. At the same time, erosion of national governments' monopoly over the development, production, and application of antisocial technologies will take place. With the advent of lower costs and more flexible modes of delivery, smaller organizations will be able to utilize antisocial technology.

There will be a growing propensity for diverse groups and organizations throughout the world to employ antisocial technologies. Protection systems against nonmilitary organizations utilizing antisocial technologies will lag seriously behind the emergence of their potential destructive capabilities. A number of dramatic instances involving nonmilitary aggression will occur somewhere in the world, and probably within U.S. territorial waters or within waters where U.S. interests are involved.

Those actors involved in the use of antisocial technologies will also be using the oceans as an avenue to enter the United States. Significant efforts will be expended to reduce or to stem this flow.

In both the military and nonmilitary realm, there will be an increasing demand for more effective protection systems. In relative terms, these demands

will emphasize greater attention to proactive protection. But there also will be a strong expectation that the reactive capabilities of protection agencies and institutions will be sufficient.

ECONOMICS

The general status of the U.S. economy, for the remainder of the century, will not change appreciably from steady long-term real growth interrupted by occasional downturns. There will be significant disruptions in specific sectors and, in some cases, the disruption will be large enough to spill over to the general economy. However, such "disruptions" will not reverse economic growth for long. There will also be sectors which will be showing strong gain.

Although there will be significant structural changes within it, the overall character of the U.S. economy will continue to be one of technological intensity. It will continue to be an economy in which overall technological leadership is seen as a cornerstone of national development.

The marine environment is on the threshold of a new historic era in which it can be described as an opening economy. The patterns of the spreading economy are occurring at a rate well below U.S. technological capacity but also well above that which would be occurring if there were no vested interest or institutionalized driving forces to "push" its development forward.

PHYSICAL RESOURCES (GENERAL FORECASTS)

Resource use or availability must not be seen only in relation to past trends or projections. If the needs of underdeveloped nations are considered, any future requirements for resources will be substantially higher.

The problems associated with the increasing resource dependency of the U.S. economy on other nations will become more acute. These problems will lead the U.S. and other nations to retreat, at least in operational behavior, from current stands which tend to reinforce the concept of a "one-world economy." This retreat will occur as it is realized that a one-world economy can function (as it is theoretically supposed to) only if there is an equivalent government, i.e., "One World Government." From this will come a continuing stream of

national priorities for relative independence in an increasing number of key resource areas. This will lead to changing priorities, policies, and incentives with respect to the development of offshore resources.

To stimulate exploitation of offshore physical resources, the federal government will provide economic incentives via the removal from private enterprises of antitrust requirement threats, subsidy of private enterprises, and organization of joint government/private corporations.

During this century, universal ownership of the oceans' resources, with effective world organizations to manage their development will not become a reality. Development will continue to be along national lines. There will, however, be a growing number of bilateral and multilateral treaties and international agreements, which will tend to affect and to "govern" the overall behavior of nations within the marine environment. Monitoring that amount of compliance will become more complicated, and more important in overall management of national and international policy.

The territorial limits of interest to the U.S. and other nations will continue to expand in terms of sea boundaries. The current 200-mile limit will not remain stable. It will be pushed outward as the economic potential and military significance of the underwater environment continues to grow. These trends will create a variety of "rights to access" conflicts, particularly in those areas involving straits or other channels of relatively narrow passage.

Suitable substitutes for the various mineral and energy resources located in the marine environment will be found. However, they will not be sufficient to depress the still basic demand for offshore resource development which is needed to supplement the U.S. and international economies. Consequently, development and reliance upon offshore resources within the territorial control of the U.S. will grow rapidly.

The systematic discovery and inventory of the earth's total nonrenewable resources and renewable resource production potential will evolve at a rapid pace. Toward the end of the century, it will be much less difficult to determine the location and amount of reserves, the rates of their depletion, and the ecological consequences of extracting them.

OCEAN MINERALS/MINING

Initially, ocean mining development will begin by the gathering of ore nodules from the ocean floor, which is an extension of current dredging concepts. These developments are already well underway, and are expected to be moving into limited application by the late 1970s and early 1980s.

As both private organizations and federal agencies become increasingly involved with ocean mining, there will be strident efforts to extend the areas of operation and attempts to gain greater competitive efficiencies by moving beyond collection and toward at-sea processing. This move toward at-sea processing may be further reinforced when the marine environment starts to become an energy supply industry. This concept will be discussed later.

As the techniques for locating geological mineral deposits under the surface of the earth become more sophisticated, more undersea mineral charts will be developed. These charts will indicate that on the continental shelf at least, there are significant ore deposits. Presently, resource deposits of this type are declining to the point that productivity increases in technology cannot make up for the economic costs of using lower grade ore. This contributes to the problems of U.S. heavy industry remaining internationally competitive. These developments are likely to open up new avenues for ocean mining which will penetrate beneath the ocean floor (i.e. closed pit mining).

The emerging ocean mining industry will see these additional mining operations as a logical extension and growth field, possibly more easily developed than going further into the ocean depths for nodules.

It is highly probable that the early development of this expansion might yield a rich vein of low sulfur coal lying near the seabed's surface, i.e., within the range of existing tunneling technology.

Such a development, when it is coupled with increasing opposition to strip mining might signal a major marriage of present technologies. The integrating of cofferdam techniques with current mining technology seems a likely example. This, in turn, would extend the potential of ocean mining dramatically because we foresee that the technological difficulties imposed by deep pit mining are probably very great. By the mid 1980s some experimental ventures of this type are likely to begin in the shallow waters of the continental shelf.

We estimate that the minerals/mining sector will be characterized by huge developmental investments and capital investment requirements. It will therefore be dominated by governments with large scale corporate enterprises in the private sector. It also will be a heavily controlled and regulated industry. The U.S. government's guarantee of protection from foreign interference will significantly affect these minerals/mining developments.

DESALINATION

We estimate that economically feasible desalination technologies will be rapidly developed during the early and mid-1980s (though probably not in the U.S.). They will be selectively "imported" and it is likely that some combination of nuclear plants and desalination complexes will exist on either coast. Other desalination plants of a nonnuclear nature will be installed though they will be few.

Our forecast that these technologies probably will not be developed in the U.S. stems from our judgment that U.S. analysts already have convinced themselves of their economic unfeasibility. But there are arid countries of the world where economic formulas will be quite different as these countries seek economic development (such as the Middle East).

If the water shortages mentioned earlier emerge, the economics of the matter within the U.S. will become entirely different than current models project. That could spawn a "crash program" for desalination within this country. As the current national laboratory resources, which were absorbed from defense technology into energy technology, work through that problem they will be seeking another role and mission. Desalination seems a likely candidate.

We believe, however, that the developments are more likely to transpire outside the U.S. and can be imported along the lines discussed above.

ENERGY

The economy will remain energy-intensive with demands for energy escalating at a rate within one-to-three percentage points of that established over the last several years.

The search for alternative energy sources and systems will grow more intense as the need for greater national energy independence increases, along with the

realization that such independence is not achievable through contemporary fossil-based energy sources.

Before the year 2000, from the standpoint of national energy usage, the marine environment will not provide significant amounts of power. Nonetheless, there will be experimental models of a number of nonfossil marine-based energy production systems.

For at least the remainder of the century, offshore oil and gas development will receive growing national priority and continue to grow at a high rate. Even the most optimistic energy forecasts indicate a fourfold increase in the consumption of fossil-based fuels by the year 2000. This is a tremendous increase in absolute terms. It will require our most rapid development of almost all known sources that have any reasonable viability.

The fact that we know so little of the undersea and subterranean deposits suggests that substantial quantities of oil and gas reserves will be discovered under the sea. It is very likely that emerging surveillance technologies will revolutionize our ability to locate deposits and take much of the current guesswork out of the picture. The percentage of successful drillings should increase substantially.

We will, however, probably discover some deep undersea deposits before we have the technology to tap them. Thus, our known reserves will likely outstrip our extraction capabilities for some time. This will act as a powerful catalyst for the rapid development of ocean extraction technologies which will perhaps reach a plateau and begin to level off by the end of the 1980s. As these technologies develop, it seems logical to expect them to provide a number of spin-offs into other aspects of the evolving marine economy.

As fossil-based deposits or other energy sources are discovered in waters of contested sovereignty, international conflicts are likely to arise which will be much more acrimonious than current ones over fishing rights. The most probable protagonists in these conflicts involving the U.S. include Mexico, Canada, the USSR and Cuba. The resulting treaties and enforcement requirements will call for additional and much more close cooperation between the Coast Guard and the Navy.

OFFSHORE POWER PLANTS

Utilizing offshore electrical generating plants will become a major area of interest. They will include facilities for nuclear power generation, and possibly fuel burning generation (especially for offshore coal), ocean thermal gradient generation, tidal and wave power conversion, and perhaps even generation by ocean currents.

The issues and fears raised by land-based nuclear generators will give rise to a movement to locate nuclear power plants offshore as a safety precaution. Yet we do not expect a rapid surge in this development. Our forecast would be for perhaps two or three experimental ventures emerging by the early 1980s. Such an idea could be given much momentum by the occurrence of a major nuclear accident. However, for planning purposes we believe it prudent to forecast that at least one or two floating nuclear experimental facilities will be within U.S. waters or under construction by the mid-1980s.

We do not expect the much-touted hydrogen economy to be a part of marine energy developments by the turn of the century. While impressive claims are made for this concept, we believe that the technical and economic problems associated with its development will preclude its entering the scene in the operational sense before the turn of the century.

The potentials for less technical marine energy production appear to be more feasible in the near term.

LIVING RESOURCE EXPLOITATION

Fishing

The fishing industry will grow significantly worldwide and substantially in terms of U.S. vessels, reversing historic trends.

We believe that the growth rates will exceed the levels obtained by using historic trend lines as the base. This escalated growth will begin to make itself felt by the mid to late 1980s. It is, however, during the late 1970s and throughout the 80s that the foundations will be developed and that a number of significant developments will emerge. The number of "flags" seeking access to U.S. waters will increase. Even now, those nations, for whom fishing is a vital economic mainstay, account for the majority of fish caught in U.S. waters.

The industry's growth will bring greater technological, institutional and economic innovations and the U.S. fishing industry will seek to be more competitive. The most basic shift (which is already underway) will be to move from a view of the fishing industry as a "hunt and bring home the kill" industry to one which compares to scientific farming, i.e., an overall cultivation, harvesting, and management process.

By the early 1980s we will have even more accurate ways of monitoring fish population and determining just what levels result in over-fishing. This will inject more requirements for allocating potential catches among contenders in terms of quotas relative to national flags as well as individual vessels.

The industry's expansion will lead toward a shift from the more traditional runs to waters of the southern hemisphere. In addition, we believe that the concept of "floating fish processing plants" now epitomized by the Russian's "floating factories" will gradually change the economics of getting fish products from the southern hemisphere to the markets of the northern hemisphere. Both improvements in the traditional small fisherman's individually owned boat and the large "factory" boat type will be cultivated. But the dominant view now held favors the small boat. Yet we do not believe that one type of vessel will replace the other. Vessels will be designed to specialize in either harvest only, or in completely processing the product in addition to harvesting.

Substantial efforts will be made to increase the productivity of fishing vessels by extending the range of marine life which they can harvest. As these developments emerge, they will also have improved quality control techniques which will be translated into regulatory requirements. Some of these requirements will specify that the grading of a catch and processing controls must take place in the marine environment rather than on land. It is conceivable that processors may locate themselves outside the economic zone in order to avoid complicity with such regulations. For example, the control of waste which may be dumped into the ocean from the plant may create major economic advantages in avoiding these regulations without reducing the acceptability of the product which is to be marketed.

Fish Farming

As the capabilities evolve for inventorying and managing the fish stock, and as total fish production increases, a variety of new approaches to the management

of fish inventories will develop. Containing fish farming areas within limited areas will most likely prove to be uneconomical except in those estuaries and bays which can be effectively barricaded. (These relatively shallow waters are also the locations most suitable to the development of certain marine plant life.) These "productive" estuaries will also be the scene of contention, for they make ideal wildlife/ecological preserves.

We believe a new area of genetics and fish culture will be conceived, in which the ocean will be stocked with fish developed in hatcheries (analogous to the present fresh water practice). These fish will be chosen for desired attributes such as their tendency to stay within a limited habitat.

It is likely that the marine environment within which these strains will remain will not coincide exactly with the 200 mile limit. This will result in the selected extension of those limits, determined by the fish habitats and justified on the basis that the host nation is stocking the waters. Selected feeding is another possibility, i.e., that process which enhances fish production or encourages fish to stay within a certain designated area.

The concept that fish resources can and should be treated like other economic resources will emerge, i.e., when they are managed and developed as distinct from hunted in the unmanaged environment, then they will become the basis for export tariffs. A variety of use tax and export tax concepts will evolve with subsequent requirements for enforcement and administration.

Marine Plant Agriculture

Various new forms of marine plant agriculture will continue emerging and at accelerated rates.

The productivity of marine plants in providing protein is already being viewed as a promising area of development, initially occurring as injections into animal feed. Commodities such as beans, alfalfa and corn are currently heavily used in animal feeds; they will gradually become more adaptable to the higher value consumer products. The use of ocean plants for biomass energy will be experimentally developed. Except in the case of kelp, these developments will be generally concentrated in the inland lakes, estuaries and coastal waters.

All of these dynamics of marine agricultural development will bring new forms of enterprise into being. Either competitive catch-up or leadership strategy will lead to the fundamental reorganization of U.S. fishing and related industries.

Inland fishing will continue to develop with the possibility that more commercial production will take place in controlled ecosystems such as lakes and ponds similar to the systems now used for catfish and other high value fish production. In addition, new management and harvesting techniques will expand the economic potential of inland waterways, particularly nonnavigable rivers, as producers of marine life for market.

TRANSPORTATION

U.S. trade will continue its expanding trend and the relative importance of marine transportation will increase. U.S. shipping capabilities and development will continue to be significant national policy issues.

Traffic density in U.S. ports will increase significantly. In an increasing number of ports, the compulsory participation of seagoing vessels in vessel traffic systems will be required, and the distances within which these traffic controls must be exercised will be extended.

This increase in traffic density and control requirements will introduce the need for new standards vis-a-vis vessel safety. As vessels become equipped with this more advanced technology, there will be a greater capability for the same equipment to be tied into improved surveillance systems which will in turn tie into search and rescue operations. Other advances in ship technology will introduce the "automated" vessel, reducing the requirements for crew size substantially. Large vessels today can function with a crew of approximately 15 persons. Forecasts show that total automation is becoming economically feasible. Pressures to continue crew size reduction will confront the Coast Guard with difficult decisions concerning minimal safe manning levels.

Automated cargo handling facilities will be installed in all major U.S. ports, offering both economic and safety benefits. Intermodal potentials will be increased and the containerization which these handling facilities will make possible will introduce new requirements with regard to the inspection and control of goods flowing in and out of the U.S. As more facilities become available, the use of standardized containers will grow significantly. We would expect that these developments should begin to emerge by the 1980s.

A select number of deep water ports will become a reality. We forecast that they will have a significant impact even though there will, in all probability, be less than a dozen of them by the year 2000. We estimate that they will be designed to handle only select materials. The present concepts relate to those materials which are transportable in large quantities by deep draft vessels unable to use conventional ports. In addition, the commodity must then be easily transportable to shore so that the economic advantage of using a large vessel is not offset by the costs of deep water porting.

Oil will continue to be the principle commodity handled by such ports. However, if some highly dangerous cargoes are involved in the future, deep water ports may be used safely, precluding the handling of hazardous materials in ports near populated areas.

Surface traffic and total tonnage shipments will show a marked increase. We believe the tonnage represented in this activity will be greater than official Department of Transportation projections and that an increasing variety of items will be taken into account in future surface transport estimates. The DOT projections are essentially trend extrapolations. If the world's resources and economic interdependence increase as we forecast, ocean shipping will increase more rapidly than the historic baselines used in making official projections.

Despite this marked increase in ton miles, the number of cargo and passenger vessels engaged in commercial transportation will not increase apace because increasing amounts of cargo will be partially absorbed by improved merchant fleet productivity and larger, faster ships (with reduced turn around time and less maintenance) will increase the tonnage carried per vessel. At the same time, some new specialized vessels will be developed such as the LNG carriers and the super tankers.

We do not expect nonmilitary underwater vessels to become a significant component of the marine environment within the next twenty-five years. They are currently not cost effective and this is not expected to change sufficiently enough to permit their rapid and large-scale commercial development. However, there will continue to emerge some additional submersibles which are of a specialized nature and which justify their high costs. Special purpose recreational vessels and some specialized craft to develop the seabed's resources are expected.

Transporting hazardous and/or polluting materials in domestic waters will significantly increase in volume and variety; consequently the number of accidents will also rise. Federal and state governments will respond with increased attention and resources devoted to safety and environmental protection. This transportation trend is already well established and will continue at a growing rate for the entire forecast period.

Even though "clean-up" technology will improve, it will not keep pace with the range of cargoes. In addition, some of the materials will become increasingly lethal. Concern for public safety will intensify politically if a dramatic accident occurs either in U.S. waters or elsewhere.

We would estimate that by the late 1980s or early 1990s there will begin to emerge an "approved for water transport" listing of materials which could be transported only by approved vessels. These developments will stimulate the development of improved navigational instruments and equipment with fail-safe features.

Travellers will be granted the right of innocent passage. However, in some instances "passage fees" may be instituted.

POLLUTION

Concern with land-originated pollutants and contaminants will continue to grow, although, for some time, it will tend to be outstripped by interest which dramatic tanker accidents generate. "Land originated" pollution control is very complex and the resolution of recognizable problems, which range throughout urban and industrial wastes, fertilizers and pesticides, and the normal by-products of natural erosion--in fact, entire continental drainage systems--will be more difficult in the future. Local control measures, in concerned nations, will be effected by 1980. Worldwide pollution controls will probably not be achieved by the end of this century, but any advances will be the result of unilateral and limited multi-lateral undertakings.

Many nations will adamantly refuse to forego the immediate gains involved in the use of insecticides and fertilizers for the long-term. This is particularly true when advanced industrial nations are seen as the primary beneficiaries.

To the extent that marine pollution will be the subject of international agreements, it appears that the concept of the oceanic river will be the dominant

legal principle involved, i.e., that the main ocean currents will be considered in the same light as continental river systems, with the rights and obligations inherent in present fluvial and riparian law applied to those nations involved.

Since problems of land-originated pollution reach back into the centers of nations, a large number of political jurisdictions and specialized interests are involved. So too are a myriad of governmental agencies and shared responsibilities. It is by no means clear how these many interests will be sorted out and accommodated. Careful attention will have to be paid to protection of organizational interests and the equitable allocation of jurisdictions, responsibilities, and resources. There will be conflicts and new forms of penalty for the invasion of one nation's ocean boundaries by another's pollution.

Various international agreements will be discussed and sought, but it seems likely that the conflicts will be resolved or pursued more or less on a case-by-case bilateral or multilateral basis. This area of conflict will continue beyond the turn of the century.

Prevention, containment, and elimination of ship-generated oil pollution will be the central concern of marine pollution control until about 1985-90. By this time, adequate technological measures and international regulatory agreements will begin to reduce the issue's prominence. In the interim, surveillance, inspection, and detection requirements relative to oil pollution will require increasing amounts of manpower, equipment, and funding. Research and development costs associated with the development of pollution control and abatement technologies during this period will be high.

Initial regulations relative to oil pollution will appear on a unilateral basis. Binding international agreements probably will be in force by 1985. The negotiating process leading to such agreements will place heavy demands upon Coast Guard personnel for advisory and expert participation.

Whether a universal convention governing control of pollution can be obtained remains uncertain for a number of reasons. Pollution control methods are expensive and will be resisted by the individuals and concerns affected--ship owners, industrial producers, etc., and by governments dependent upon successful operation of such enterprises. Lesser developed countries are apt to see sponsorship of expensive pollution control measures as a plot to inhibit further their development and economic progress. Since nations are affected in different amounts by oceanic pollution, their "control" motivations may well differ. Laxity in pollution control

enforcement could attract certain industrial concentrations, much as favorable treatment has generated the large rate of "flag-of-convenience" ship registrations. Thus, some nations could be positively motivated to counter majority sentiment.

All nations may be expected to resist any infringement upon the traditional freedom of their merchant shipping on the high seas. Consequently, even when international agreements relative to ship-generated pollution are arrived at, enforcement will probably remain a local prerogative.

In consequence of the foregoing considerations, truly comprehensive international pollution control agreements may be difficult to develop. Most progress will be made in unilateral actions and bilateral or limited multilateral agreements. Enforcement probably will be limited to actions within territorial waters. The question of control within nonterritorial, but pseudo-sovereign areas, i.e., economic zones, will be the source of considerable controversy and antagonism.

The present rigid antipollution absolutism will be complemented by a modified waste management system which will seek to define what waste matter various areas of the ocean and inland waterways may accept and in what quantities. It will "process" the waste as an allowable aspect of its ecosystem. Major areas of research will lead to understanding these relationships. "Disposal" charges are a likely prospect as are monitoring requirements.

It is especially likely that some processing plants will acquire an economic advantage by being at sea; for example, a commercial venture is reportedly underway now to build a floating meat processing and packing plant to cruise the coast of Africa. The idea is to take the plant to the cattle rather than incurring transit losses. The concept would deposit certain waste into the sea as a "food" for lobsters and other sea delicacies which they would also harvest and process.

It is also known that nitrogen and certain other minerals are needed for marine life. Used in conjunction with marine agricultural resource management, wastes from such plants will open many avenues not now even defined.

We would expect these concepts to emerge even in this decade, with modest but rapidly increasing applications throughout the remainder of the century.

In time the marine environment will come to be seen as a component of an overall waste disposal/management system. In this sense, antipollutants and pollution control procedures will continue to be important and grow in absolute

terms. However, they will decrease proportionately in favor of concepts which consider the offshore environment as a natural disposal system. Parallel with, and complementary to this concept, will be the emergence of positive management. Some wastes may be regarded as nutrients which increase the productivity of the marine environment, especially agricultural productivity.

As technology and surveillance emerge, pollution detection devices and techniques will expand dramatically during the 1980s and then begin to level off. This will be paralleled by complementary, and often integrated, monitoring devices to show what types of waste can be deposited in what sections and in what amounts. In essence, these monitors will say what waste the ocean requires to fulfill other marine management objectives, what wastes it can accept and when the "dump is full" or closed temporarily until natural processes have been completed.

These detection devices will first be applied from vessels (much like current pollution tests) with the later application of remote sensors. Many of these devices will employ remote sensing capabilities--some from satellites, some from aircraft, some from floating monitors, some from patrolling vessels, and some mounted on the ocean bottom.

By the turn of the century, the entire network of marine waste/pollution management and control will be conceived as a subsystem with a network of sensors and probably a computerized control center(s) to coordinate and monitor the overall system itself.

OFFSHORE LOCATION OF PROCESSING PLANTS AND HABITATS

Offshore processing plants will become increasingly prevalent in the oceans. Already industries are constructing demonstration plants.

The idea of "floating factories" for fish and seafood is already advanced and in operation. Various marine-based energy plants will be built experimentally. These will tend to be fixed-location facilities. Other processing plants likely are those connected with minerals and ores pulled from the marine environment and probably employed in conjunction with marine energy production facilities.

Houseboats which double as marine recreational and living vehicles will be used more extensively. Their use will be concentrated around docks and marinas designed to accommodate this style of life, not unlike trailer parks which have grown to accommodate land mobile homes.

We expect that at least several thousand such living units will emerge by the early 1980s. It will result from a combination of converging patterns, including: earlier retirement of many persons who will wish to spend much of their retirement life in the marine environment and who will not wish the expense of duplicate housing; the drastically increasing inflationary costs of housing which actually is an adaptation to the already booming concepts of land mobile homes; the continued growth of the recreational/leisure use of the marine environment; the possibility that at least some persons will become employed in at-sea facilities, and will wish to be more mobile in terms of home facilities while at the sea-site.

Once the idea begins to take hold and the supply industry becomes oriented to the concept, promotional activities could lead to a sustained and rather rapid "boom" in this sector for several years. Should that occur, it would not likely start before the early 1980s and then would be sustainable throughout the 1980s and 1990s. There could be several million such units by the end of the century.

"Floating cities" as envisioned by some forecasters will not, in our view, be a factor in this century. There is, however, a possibility that one or two very small multiple family "floating communities" of up to several hundred families may emerge.

These most likely would be some affluent version of the Aberdeen community in Hong Kong, or they would be connected with the processing plants to bring together the workers or the workers and their families. It seems most likely that these developments will not occur before the mid-1990s.

These emerging fixed structures and appeals for access to undersea deposits will increase hazards and result in demands for precise navigational control systems.

CLIMATE AND NATURAL FORCES/DISASTERS

Overall climatic trends for the remainder of the century will, in comparison to the past 25 years, be adverse. On a worldwide basis, average temperatures will drop, growing seasons and agricultural productivity will suffer, and changes

in customary weather patterns will be common. Certain areas (probably including main U.S. agricultural belts) may be less adversely affected than the world average, and may even enjoy some improvements.

These circumstances will provide significant economic and political advantages for the United States for the 1980s. They will also subject the U.S. to numerous moral and humanitarian pressures which may be satisfied only by the sacrifice of some major national interests. Beyond the 1980s, alternative sources for nutrition are likely to erode any U.S. advantage. Marine agriculture (from a world standpoint) will be a major part of alternative nutrition systems.

Requirements for harbor ice clearance services will rise and variations in weather patterns will render effective prepositioning of assets very difficult. At the same time, the economic importance of assuring ice clearance will increase significantly. The incidence of storms and reduced visibility will increase, complicating marine navigation.

Climatology has long been the least predictive of the natural sciences, but present and potential technological and scientific developments offer the possibility of multifold improvements in predictive capability. There is a better than even chance that a quantum improvement in weather prediction capability will occur by the end of this century. Yet any advances which occur will be manifested in broad-scale, continental and major area terms. Localized and short range forecasts will remain subject to a considerable error.

Maritime areas have long been recognized as an important component of world climate determinants. As climatological determinants become better understood, it is probable that requirement for more extensive, detailed, and exotic marine data collection will increase.

Improved weather forecasting technology will probably provide a manipulative capability in regard to world or local weather patterns. It is impossible to state whether truly effective manipulative capabilities will emerge by the end of this century. Considering, however, the capabilities which increased predictive and manipulative powers will confer, monitoring of progress in this area should be one of the highest national priorities.

Present weather manipulation, such as cloud seeding to induce rainfall, has not been overly successful, and appears to be encumbered by a number of legal and moral considerations. Suggestions for major weather modification projects, such

as a dam in the Bering Sea for moderating Siberian winters, have already appeared in print. Although there is no evidence that such projects have been seriously considered by any nation, the mere existence of such conjecture is sufficient justification to warrant monitoring technical and scientific improvements.

As a more comprehensive scientific understanding of the structure and operation of the world climatic system emerges, it is conceivable that the greatest impact will lie not in exotic technologies of rain-making, hurricane control, etc., but in behavioral limitations which increased knowledge suggests may be mandatory. That is, such activities as extensive lumbering, irrigation, drainage, certain types of farming and grazing practices, etc., may become recognized as hazardous--because of their impact upon world weather patterns--to general welfare.

The natural forces which can present threats to the marine environment are of several types: climatic forces, such as hurricanes, fog, temperature, and various other weather phenomena; geophysical forces, such as earthquakes, volcanic eruptions, the rise and fall of land masses, and other shifts in the earth's crust; oceanic forces, including tides, currents, waves, and various other physical movements of the marine environment; marine life, including dangerous species such as sharks, and predators on commercial marine life, and intrusion of undesired plant life.

The predictive capabilities, plus the lack of capacity to have a fully effective preventive system to control threats from natural phenomena, will result in complementary demands to use those predictions and capabilities within a proactive framework. A system of adequate surveillance, rapid alert and appropriate evaluation, or other "damage deterrent" procedures, will be employed. Also employed will be engineering standards for equipment design, such that the capacity to withstand calculated levels of natural forces is a part of operational equipment.

The mechanisms and concepts required to evolve this type of protective system are already in place. Basic differences will be in substance and detail rather than in entirely new requirements. However, some novel approaches may be experimentally developed, such as having underwater habitats as shelters or refuge for workers in offshore facilities from storms or other surface hazards.

RECREATION

One of the most rapidly growing areas of marine use has been its employment as a recreation and leisure activity site. This includes both boating and nonboating

activities. We believe this growth will continue throughout the forecast period. The number of activities will grow significantly though by the 1990s the base may have reached such proportions as to begin reflecting a reduced rate of growth. Private boating, recreational flying over the water, and sports activities in or near the water (such as skiing and diving) will continue to grow significantly.

At least a few highly selected unique recreational/leisure uses of the marine environment will emerge by the early to mid-1980s. They will include a number of underwater observation centers in "marine parks" (an extension of the idea of marine lands and aquariums), and also application of the commercialized concept of "theme parks." In particularly suitable areas (such as the waters off the coast of Florida) there likely will be a few innovative underwater restaurants and overnight facilities. These will feature both observation and study of marine life and various aquatic sports such as scuba diving.

These facilities likely will be equipped with "tourist" types of submersibles to take an excursion through the deep. Such "excursion subs" are also likely to appear once they are introduced in various waterfront communities as an extension of their vacation attractions. Should this idea catch on it could grow quite rapidly with several hundred or even several thousand such vessels in operation by the early 1990s.

Aesthetic preservation will continue to be a major political and economic issue with respect to the tapping of offshore resources. Recreational demands and underwater conservation areas will gain political power, thus increasing pressure to protect the undersea world.

Research and Development

Scientific interest and exploration of the marine environment will expand rapidly. Instrumentation, techniques, and all areas of ocean or marine science will be advancing. These trends will undergrid the entire range of activities, which will be associated with the development of the offshore resources and activities.